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**EFFECT OF WORLD MUSIC DRUMMING ON AUDITORY  
AND VISUAL ATTENTION SKILLS OF ADHD  
ELEMENTARY STUDENTS**

**DISSERTATION**

**Presented in Partial Fulfillment of the Requirements for the Degree of  
Doctor of Philosophy  
Lynn University**

**By**

**Shannon Michael Chacona**

**2007**



**Order Number:** \_\_\_\_\_

**EFFECT OF WORLD MUSIC DRUMMING ON AUDITORY  
AND VISUAL ATTENTION SKILLS OF ADHD  
ELEMENTARY STUDENTS**

Chacona, S., Ph.D.

Lynn University, 2007

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## ABSTRACT

ADHD is the most widespread childhood disorder in the United States today, affecting approximately 2 million children. Attention disorders, occurring in 5% to 10% of children are usually referred because of hyperactivity. Yet, only half of children with attention disorders are hyperactive. Research indicated between the years 1993 and 2003; the number of ADHD-related doctor visits grew from 3.2 million to 7.4 million. This increase led to a rise in stimulant medications prescribed by physicians. Despite evidence of some improvement in symptoms of ADHD following medication treatment, many are still concerned about the possible side effects that may arise due to the lasting effect of pharmacological treatment. This study was designed to address these concerns by testing a non-pharmacological, education-based intervention to assist children in building attention skills.

A self-selected, data producing sample of 60 elementary school students identified with attention difficulties on the BASC participated in this quantitative, causal-comparative, and experimental study. Descriptive statistics analyzed sample characteristics, while multiple regression and *t*-tests were used to examine relationships and differences, respectively, related to the effect of World Music Drumming on attention skills, as measured by errors of omission and commission, and response time on the TOVA, Auditory and Visual.

Results indicated that students who participated in World Music Drumming had a significant decrease in TOVA auditory and visual skills test percentage of commission error scores, but no significant decrease in TOVA auditory and visual skills test percentage of omission error scores. Although auditory skills response time scores

decreased for both the experimental and control groups when comparing pre-test and post-test scores, the decrease was not significant using parametric tests. Results of nonparametric tests found marginally significant decreases in auditory skills test response time scores among the experimental group. Therefore, participation in World Music Drumming did not have a significant effect on visual skills response time scores of students who participated, but it did have a marginally significant effect on their auditory skills response time scores. Recommendations for future study include the use of a larger accessible population; address additional attribute variables; and use scaled rather than ordinal BASC scores.

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## **CHAPTER I**

### **INTRODUCTION TO THE STUDY**

#### **Background to the Study**

There are many children who have difficulty paying attention. Some children not only struggle with inattentiveness, but also concerns with hyperactivity and impulsivity. Many children will overcome these difficulties with maturity. But for other children, getting control of this issue will be the most difficult obstacle encountered at such a young age. The realization for some, that these difficulties with attention, hyperactivity, and impulsivity are part of who they are, may be the key to finding a way to deal with the issue. Children who struggle with these difficulties can exhibit an array of behaviors, which can include daydreaming, restlessness, and a short attention span. These children may find it very difficult to follow directions, and impossible to stay organized. These types of difficulties can cause children stress in all areas of their lives. Research has shown that difficulties with inattentiveness, hyperactivity, and impulsivity can interfere with a child's academic and social development, which can result in failing grades and poor self-esteem (DuPaul, McGoe, Eckert, & VanBrakle, 2001).

Most children who experience serious concerns in the areas of attention, hyperactivity, and impulsivity are diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD). ADHD can manifest itself in a person's educational environment, social development, family dynamics, and career aspirations by impairing one's ability to function by our society's standards (DuPaul & Stoner, 2003). The American Psychiatric Association (2000) describes an ADHD person as more inattentive, more hyperactive, and more impulsive than a non-ADHD person at the same developmental level. ADHD

studies support this assessment and further agree that a diagnosis of ADHD must meet additional criteria. For ADHD to be diagnosed, the following criteria apply: 1) some of the symptoms associated with the disorder must be present before a child turns seven years old; 2) the symptoms must impact the individual's ability to function normally in at least two environments; and 3) the symptoms associated with ADHD are not due to any other disability (American Psychiatric Association [APA], 2000; Barkley & Grodinsky, 1994; Shaywitz, Fletcher, & Shaywitz, 1994, 1997). Although the DSM-IV states that ADHD symptoms must be present prior to age seven, in reality, the majority of children are not diagnosed until intermediate elementary school, middle school, or even high school (Zentall, 2006).

The most widespread disorder that affects children in the United States is ADHD (National Institute of Health, 2000). It is believed that up to two million children are diagnosed with ADHD (Zentall, 2006). Attention disorders, occurring in 5% to 10% of children are usually referred because of hyperactivity. Yet, only half of children with attention disorders are hyperactive (Scahill et al., 2004). Research suggests that gender is a factor in identifying children with ADHD; on average four boys are identified with ADHD symptoms for every girl that is identified (August, Realmuto, MacDonald, Nugent, & Crosby, 1996; Carlson, Tamm, & Gaub, 1997; Gershon, 2002; Greenblatt, 1994; Wolraich, Hannah, Baumgaertel, & Feurer, 1998; Zentall, 2006). It has also been reported that 44% of students receiving special education services are diagnosed ADHD (Bussing, Zima, Perwien, Belin, & Widawski, 1998).

ADHD is believed to originate in early childhood (Barkley, Fischer, Newby, & Breen, 1988; DuPaul et al., 2001) and is viewed as a genetic, neuropsychological disorder

that is affected by a person's environment (Barkley, 1998; Weyandt, 2001). Children who are diagnosed with ADHD often act impulsively, have difficulty resisting distractions, attending to tasks, and remaining seated (APA, 2000). Children with ADHD are often aggressive, noncompliant, or disruptive. DuPaul & Stoner (2003) believe the social performance of children with ADHD is a serious problem. This concern can lead to social problems spanning from childhood, through adolescence, and into adulthood (LeFever, Villers, Morrow, & Vaughn, 2002). Recent findings indicate that ADHD is a lifelong disorder that is neurologically based (Weyandt, 2001).

Children diagnosed with ADHD tend to have more academic problems than their peers. ADHD children are retained, suspended, and expelled from school more often than non-ADHD children and utilize Exceptional Student Education (ESE) programs more often than non-ADHD children (LeFever et al., 2002). Research suggests that approximately half the children diagnosed with ADHD will receive educational services through ESE (Reid, Maag, Vasa, & Wright, 1994). For those with attention difficulties that do not qualify for ESE services, educational accommodations can be given through the American with Disabilities Act, Section 504 (Reid & Katsiyannis, 1995). Regardless of these educational possibilities, the majority of ADHD students will receive services in the general education classroom (Reid et al., 1994).

Research indicates between 1993 and 2003 the number of ADHD cases increased drastically, with the number of ADHD-related doctor visits growing from 3.2 million to 7.4 million (Toh, 2006). This increase has led to a rise in stimulant medications being prescribed by physicians to assist children in school. This rise in medication use has been controversial. The effectiveness of the different interventions utilized to treat ADHD is

continuously debated. Many researchers believe that no single intervention for children with ADHD is effective by itself (Muscott & Guilford, 1994). While stimulant medication has shown results in treating symptoms of ADHD (Abikoff & Gittleman, 1985; Zuvekas, 2006), some suggest that treatment will be most effective when pharmacological treatment is paired with psychosocial, behavioral, and cognitive-behavioral treatment strategies (Greene & Ablon, 2001; Hoza, 2001; Pelham & Gnagy, 1999). The effects of medication on academic performance in children with ADHD have been questioned (Aschenbrenner, 2006; Cohen, Jhung, & Budnitz, 2006; Goldstein & Goldstein, 1992; Wolraich, 2006). Some studies suggest that there is little improvement on academic performance despite the improvement in behavior (Rapport, Denny, DuPaul, & Gardner, 1994; Swanson, McBurnett, Wigal, & Pfiffner, 1993). Despite evidence of some improvement in symptoms of ADHD following medication treatment, many are still concerned about the possible side effects that may arise due to the lasting effect of pharmacological treatment (Charach, Ickowicz, & Schachar, 2004; Ervin, Bankert, & DuPaul, 1996). With the growing concern over the increase in diagnosis of ADHD and the rate that medications are being prescribed as the primary method of treatment, it is believed by this researcher that it is important to seek non-medical, educational interventions to assist children in overcoming the effects of this disorder.

### **Purpose**

The general purpose of this experimental, causal-comparative, and explanatory study was to examine a nonpharmacological, education-based treatment intervention to improve attention skills in students with attention difficulties. This study involved the rehearsal of steady beats in an instructional setting using World Music Drumming to



examine the effect on ADHD at-risk and clinically significant elementary school students. The specific purposes of this study involved conducting descriptive statistics, including measures of central tendency, and frequency distributions; multiple regression analyses; independent (between groups) samples *t*-tests, and paired (within groups) samples *t*-tests to examine the following:

1. Exploration of gender, age, estimated grade level, and BASC classification of the second through fifth grade students with attention difficulties who participated in this study.
2. Exploration of the pre-test and post-test TOVA auditory and visual percentage of error scores and response time scores of the second through fifth grade students with attention difficulties who participated in this study.
3. Exploration of the relative contribution of the gender, age, estimated grade level, and BASC classification of second through fifth grade students with attention difficulties in explaining their TOVA scores.
4. Examination of the difference in TOVA auditory and visual skills percentage of commission (impulsivity) error scores, omission (inattention) error scores, and response times between pre-test and post-test administration of second through fifth grade students with attention difficulties participated in the seven-week World Music Drumming program.
5. Examination of the difference in TOVA auditory and visual skills percentage of commission (impulsivity) error scores, omission (inattention) error scores, and response times between pre-test and post-test administration of second

through fifth grade students with attention difficulties who did not participate in the seven-week World Music Drumming program.

6. Examination of the difference in TOVA auditory and visual skills percentage of commission (impulsivity) error scores, omission (inattention) error scores, and response times between pre-test and post-test administration between second through fifth grade students with attention difficulties who did participate in the seven-week World Music Drumming program and those who did not participate in the program.

### **Definition of Terms**

Theoretical and operational definitions of key terms are provided in this section. Theoretical definitions of the key terms and variables included in this study are based primarily on psychological reference materials and literature related to instrumentation. Operational definitions of the key terms and variables refer to the specific means by which they are observed and measured in this study (Best & Kahn, 2003).

#### ***Attention Deficit/Hyperactivity Disorder (ADHD)***

##### ***Theoretical Definition***

The American Psychiatric Association (2000) describes ADHD as a persistent pattern of inattention, hyperactivity, and impulsivity that is more frequent and severe than is typically observed in individuals at a comparable level of development (Criterion A); with some symptoms present before age 7 years (Criterion B) in at least two settings (Criterion C); that interfere with developmentally appropriate social, academic, or occupational functioning (Criterion D); and is not better accounted for by another mental disorder.

### ***Operational Definition***

In this study, ADHD was defined by students' BASC scores. Students categorized as either at-risk or clinically significant in the area of attention on the Behavior Assessment System for Children (BASC) were included in the study (Reynolds & Kamphaus, 1992).

### ***Test of Variables of Attention (TOVA, Visual and Auditory)***

#### ***Theoretical Definition***

The TOVA, Auditory and Visual, are individually administered computerized tests developed to assess attention and impulse control in normal and clinical populations. The TOVA was developed to measure attention and impulse control processes in three areas: 1) inattention or omissions; 2) impulse control or commissions; and 3) response time in milliseconds (Greenberg, 2000).

#### ***Operational Definition***

In this study, the TOVA was a computerized test that measured auditory and visual attention and was utilized as a pre-test and post-test measure in the research study to determine the effect of the independent variable, participation in the World Music Drumming intervention, on the dependent variables of visual and auditory attention skills.

### ***Behavior Assessment System for Children***

#### ***Theoretical Definition***

The BASC is a rating scale used to identify behavior concerns in children. The BASC results are based on the teacher's and parent's rating of a child's behavior, both at school and at home. A clinically significant score or classification on the BASC

identifies a high level of maladjustment in a specific area that needs to be addressed. An at-risk score or classification on the BASC identifies a possible concern in a specific area that may have the potential to develop into something more serious and should be carefully monitored. The BASC includes scales for assessing hyperactivity, inattention, conduct problems, internalizing problems, and adaptive behaviors (Reynolds & Kamphaus, 1992).

### ***Operational Definition***

In this study, students with BASC classifications of at-risk and clinically significant in the area of attention were identified as the total accessible population (Reynolds & Kamphaus, 1992).

## ***World Music Drumming***

### ***Theoretical Definition***

World Music Drumming is a cross-cultural curriculum which meets the national and state standards for music education. This program was developed in 1998 to teach drumming, respect for different cultures, and how to communicate and work together. World Music Drumming utilizes a drum circle and a call and response technique (Schmid, 1998).

### ***Operational Definition***

In this study, participation in the World Music Drumming program was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions) covering Unit 1: Beginning to Ensemble 1 of the World Music Drumming curriculum (Schmid, 1998).

## ***Auditory Attention***

### ***Theoretical Definition***

The ability to pay attention as it relates to the sense of hearing (Greenberg, 2000).

### ***Operational Definition***

In this study, auditory attention was measured by the student's ability to correctly identify the target auditory stimuli or note (Middle G) from the non-target auditory stimuli or note (Middle C) played on the computer by clicking a micro-switch as soon as the target auditory stimuli or note was sounded. The auditory attention of each student was measured by calculating the errors of commission, errors of omission, and response time in milliseconds (Greenberg, 2000).

## ***Visual Attention***

### ***Theoretical Definition***

The ability to pay attention as it relates to the sense of sight (Greenberg, 2000).

### ***Operational Definition***

In this study, visual attention was measured by the student's ability to correctly identify the target visual stimuli from the non-target visual stimuli, which consisted of two geometric pictures centered on the computer screen. The target visual stimuli appeared at the top of the computer screen, while the non-target visual stimuli appeared at the bottom of the computer screen. The student needed to click the micro-switch as soon as the target visual stimuli appeared on the computer screen. The visual attention of each subject was measured by calculating the errors of commission, errors of omission, and response time in milliseconds (Greenberg, 2000).

## ***Response Time***

### ***Theoretical Definition***

The measure of processing time in milliseconds it takes a subject to respond correctly to a target (Greenberg, 2000).

### ***Operational Definition***

In this study, response time was an electronic measure of time from when a target was presented to when the micro-switch was pressed by the subject. The response time was measured as the average of the total correct response times divided by the number of targets reported in milliseconds (Greenberg, 2000).

## ***Errors of Omission***

### ***Theoretical Definition***

Errors of omission are a measure of inattention (Greenberg, 2000).

### ***Operational Definition***

In this study, errors of omission occurred when the subject did not respond to the designated target; the subject omitted pressing the button when the target was presented (Greenberg, 2000).

## ***Errors of Commission***

### ***Theoretical Definition***

Errors of commission are a measure of impulsivity or disinhibition (Greenberg, 2000).

### ***Operational Definition***

In this study, errors of commission occurred when the subject failed to inhibit responding and incorrectly responded to a non-target; the subject pressed the button when a non-target was presented (Greenberg, 2000).

### **Assumptions**

The following assumptions contributed to the development of this research study:

1. The association between ADHD and World Music Drumming is important because World Music Drumming appears to assist children in developing attention skills through the drum circle activities. The drum circle activity of call and response encourages children involved to focus through sight and sound on the beats being played by the drum circle leader; which could possibly build attention skills.
2. If the World Music Drumming program has a positive effect on the auditory and visual attention of students identified with attention difficulties at the South Florida elementary school, this education-based approach may be utilized to assist students with attention difficulties in strengthening their attention and concentration skills, which could possibly lead to improved academic performance.
3. Only the students that receive the World Music Drumming program as intervention will decrease their errors of commission, errors of omission, and response time on the post-test of the TOVA, Auditory and Visual.

## **Justification**

Among childhood psychiatric disorders, ADHD is identified more often than any other condition (National Institute of Health, 2000). Many children diagnosed with ADHD experience significant problems in school and are two to three times more likely to be retained than their peers (Greene, Beszterczey, Katzenstein, Park, & Gorings, 2002; LeFever et al., 2002). The Appalachia Educational Laboratory (1995) reports ADHD children have a greater risk of being retained than non-ADHD children by the time they reach high school. Further, it is estimated that over one-third of students diagnosed with ADHD will not complete high school (Barkley, 1990). Research indicates that no single intervention for children with ADHD is effective alone, due to the amount of symptoms associated with the disorder (Muscott & Guilford, 1994). It is believed that the best approach to intervention is when medication treatment is coupled with therapeutic, behavioral treatment strategies (Greene & Ablon, 2001; Hoza, 2001; Pelham & Gnagy, 1999). The effects of medication on academic performance in children with ADHD have been questioned (Aschenbrenner, 2006; Cohen et al., 2006; Wolraich, 2006). Some studies suggest that there is little improvement on academic performance despite the improvement in behavior (Rapport, et al., 1994; Swanson et al., 1993). Despite evidence of some improvement in symptoms of ADHD following medication treatment, many are still concerned about the possible side effects that may arise due to the lasting effect of pharmacological treatment (Charach et al., 2004; Ervin et al., 1996). This study was designed to address the concerns associated with medication being used as the primary treatment for ADHD children, along with little evidence showing academic improvement in ADHD children following medication treatment. This study is significant because it



attempts to use World Music Drumming as an intervention to build attention skills in ADHD children instead of medication treatment. This research may contribute to further study by establishing a tested nonpharmacological intervention technique to be used in schools to assist ADHD children in overcoming their disability. This research study was possible due to the availability of subjects at the researcher's elementary school and the adequate amount of time available to complete the project. This topic was able to be researched due to a clearly defined problem and ability to measure each variable in the study.

### **Delimitations and Scope**

The researcher had access to the entire target population of 70 students at the South Florida elementary school identified as at-risk or clinically significant in the area of attention on the BASC. Sixty of the 70 students in the target population were allowed to participate in the study based on parental permission. The data producing sample of sixty students who participated in the study was limited to a South Florida elementary school. The sample consisted of 30 students in the experimental group and 30 students in the control group. This experimental study sought to explain the effect of World Music Drumming on the auditory and visual attention skills of students identified as having attention concerns. Data analyzed included pre-test and post-test error scores on the TOVA, Auditory and Visual, the differences between pre-test and post-test error scores, and response times for both TOVA test types.

An overview of the research study was provided in Chapter I, including the definition of the problem, the purpose and justification of the study, definitions of variables, and limitations of the study. Chapter II presents a review of the past empirical

research and theories that led to the research questions and hypotheses to be examined. The review of research led to the identification of gaps in the literature which consist of the following: 1) medication treatment has not shown sufficient academic improvement in ADHD children; 2) adequate research has not been conducted on school-based, behavioral intervention techniques to assist ADHD children; and 3) little research has been conducted using music to treat the symptoms of ADHD. The theoretical framework presented in Chapter II emphasizes the need to further investigate behavioral intervention techniques, specifically self-regulation, in the treatment of the symptoms of ADHD. Chapter III presents the methodology of the research study used in answering the research questions and testing the hypotheses for this study about the effect of a drumming intervention on the auditory and visual attention skills of students with attention difficulties. Chapter IV presents the results of the data analyses performed in order to answer the research questions and test the hypotheses of this study. Chapter V presents a discussion of the interpretations, limitations, practical implications, conclusions, and recommendations pertaining to this study, based on the literature and findings related to the effect of World Music Drumming on the auditory and visual attention skills of attention deficit hyperactivity disorder (ADHD) at-risk or clinically significant elementary students.

## **CHAPTER II**

### **REVIEW OF THE LITERATURE, THEORETICAL FRAMEWORK, RESEARCH QUESTIONS, AND HYPOTHESES**

#### **Review of the Literature**

##### *Introduction*

Attention Deficit/Hyperactivity Disorder (ADHD) is a condition of inattention, hyperactivity, and impulsivity that affects a great number of children throughout the world (Faraone, Sergeant, Gillberg, & Biederman, 2003). ADHD research documents the continued controversy over diagnosis and treatment of the disorder (Barkley, 1997; Bowd, 2006; Cherkes-Julkowski, Sharp, & Stolzenberg, 1997; Strayhorn, 2002). The majority of research hypothesizes that ADHD is a combination of genetic and environmental factors (Cherkes-Julkowski et al., 1997; Greene & Barkley, 1996), with some treatment focusing on psychopharmacological intervention (Kollins, Barkley, & DuPaul, 2001; Rains & Scahill, 2006; Scahill, Carroll, & Burke, 2004) and some focusing on therapeutic interventions (Barkley, 1990; Braswell & Bloomquist, 1989; Cocciarella, Wood, & Low, 1995; DuPaul & Stoner, 2003; Gordon, Thomason, Cooper, & Ivers, 1991; Hoza, 2001; Reid & Harris, 1993; Vance & Luk, 2000; Wells, Epstein, & Hinshaw, 2000). Although many ADHD children treated with medication show some improvements in behavior, there is little research evidence showing sustained improvement in academics and socialization (Pelham, Wheeler, & Chronis, 1998). There is also concern about the possible side effects that may arise due to the lasting effect of pharmacological treatment (Aschenbrenner, 2006; Charach et al., 2004; Cohen et al., 2006; Ervin et al., 1996; Rapport & Moffitt, 2002; Wolraich, 2006).

The concern over how to treat ADHD has lead researchers to investigate nonpharmacological interventions to assist children in overcoming the disorder. A common theme emerges from three theoretical models of ADHD identified in the review of literature, emphasizing one primary characteristic that affects multiple areas of functioning (Zentall, 2006). Despite each theoretical model naming different primary characteristics behind ADHD, there is a common focus in treatment. Each theoretical model points toward building self-regulating or self-monitoring techniques in ADHD children. These techniques are a way for students to self-regulate or self-monitor their behavior in different environments in order to decrease the symptoms of ADHD (Kern, Ringdahl, Hilt, & Sterling-Turner, 2001).

Research has suggested music can improve concentration, hyperactivity, and other attention-related skills in children (Cripe, 1986; Montello & Coons, 1998; Rickson, 2006; Shehan, 1981; Wilson, 1976). Music has also been shown to encourage relaxation in children (Gunter, 1995), along with improving behavior when played (Chalmers, Olson, & Zurkowski, 1999). In children diagnosed with ADHD, music therapy has been viewed as effective by teachers, parents, therapists, and children involved in the treatment of ADHD symptoms (Jackson, 2003). A study by Rickson (2006) comparing an instructional model and an improvisational model of music therapy on ADHD boys resulted in non-statistically significant improvement in impulsivity after the instructional session was delivered. These findings suggest the need for further study in this area. The purpose of this review of theoretical and empirical research was to describe ADHD and its related behaviors and treatment, with an emphasis on music as a nonpharmacological intervention for the symptoms of ADHD.

### ***Attention Deficit Hyperactivity Disorder (ADHD)***

The most widespread disorder that affects children in the United States is ADHD (National Institute of Health, 2000). Research indicated between 1993 and 2003 the number of ADHD cases increased drastically, with the number of ADHD-related doctor visits growing from 3.2 million to 7.4 million (Toh, 2006). During this time, it was estimated between 8% and 20% of school-age children exhibited behaviors that could lead to a diagnosis of ADHD, with 3% to 7% of those children manifesting behaviors severe enough to need services (Shaywitz & Shaywitz, 1997). It has also been reported that 44% of students receiving special education services have been diagnosed with ADHD (Bussing, Zima, Perwien, Belin, & Widawski, 1998). Currently, it is estimated up to 2 million U. S. children are diagnosed with ADHD (Zentall, 2006). Attention disorders, occurring in 5% to 10% of children are usually referred because of hyperactivity. Yet, only half of children with attention disorders are hyperactive (Scahill et al., 2004).

Research suggests that gender is a factor in identifying children with ADHD; an average of four boys are identified with ADHD symptoms for every one girl that is identified (August et al., 1996; Carlson et al., 1997; Gershon, 2002; Greenblatt, 1994; Sciutto, Nolfi, & Bluhm, 2004; Wolraich et al., 1998; Zentall, 2006). Greenblatt (1994) studied gender and ethnicity bias in the assessment of ADHD and found educators identified 27% of girl cases compared to 72% of boy cases to have ADHD when asked to evaluate case studies of children described as hyperactive, impulsive, and inattentive. Some possible explanations for this discrepancy are girls typically do not manifest symptoms of ADHD the same as boys, along with girls have a tendency to be more

receptive to redirection by the teacher than boys (Zentall, 2006). Boys were also reported to take medication to treat ADHD more often than girls, with medication usage increasing throughout an academic career (LeFever, Dawson, & Morrow, 1999). ADHD can be found in almost all cultures and most countries throughout the world (Faraone, Sergeant, Gillberg, & Biederman, 2003; Fraser & Moltzen, 2000; Simeon & Wiggins, 1993). ADHD is considered to be the most common behavior problem in childhood today (Vance & Luk, 2000), and the way it is viewed throughout the international community varies greatly based on the sociocultural perceptions of development and the way children are taught (Bird, 1996; Fraser & Moltzen, 2000; Jerome, Gordon, & Hustler, 1994; Vance & Luk, 2000).

ADHD impacts an individual's ability to control his or her motor activity, to screen out distracting stimuli, and think before acting (Silver, 1990). Children diagnosed with ADHD often show inconsistencies in their performance ability (DuPaul & Stoner, 2002, 2003). Due to the symptoms of the disorder, children diagnosed with ADHD often have a difficult time managing their behavior in order to respond appropriately in and out of the classroom (Shapiro, DuPaul, & Bradley-Klug, 1998). Many children diagnosed with ADHD experience significant problems in school (Greene et al., 2002; LeFever et al., 2002). ADHD children are retained, suspended, and expelled from school more often than non-ADHD children and utilize Exceptional Student Education (ESE) programs more often than non-ADHD children (LeFever et al., 2002). Further, it is estimated that over one-third of students diagnosed with ADHD will not complete high school (Pfiffner & Barkley, 1990). Children with ADHD have great difficulty completing school assignments, whether in the classroom or at home. It is common for ADHD children to

either procrastinate and complete assignments at a slower pace or rush through assignments, making careless mistakes producing work of poorer quality (Barkley, 1990; Davies & Witte, 2000; Frick, Kamphaus, Lahey, Loeber, Christ, & Hart, 1991; Reif, 1993). It is also common for ADHD children to misunderstand or incorrectly write down the assignments given by the teacher. (Epstein, Polloway, Foley, & Patton, 1993; Power, Karustis, & Habboushe, 2001). The U. S. Department of Health and Human Services (1999) reported the difficulties faced by children diagnosed with ADHD are exacerbated when these children grow up in low-income urban communities. Due to the fact that the public school system provides 70% to 80% of services to assist low-income urban communities (Burns, Costello, Angold, Tweed, Stangl, & Farmer, 1995; Rones & Hoagwood, 2000), educators today not only need a better understanding of ADHD but also a more progressive method to help assist children diagnosed with the disorder.

ADHD was previously classified under several different labels. It has been viewed as a medical problem, a behavioral problem, an environmental problem, a hyperactivity problem, and a problem with paying attention. More specifically, ADHD has been described by the following diagnosis: Restlessness Syndrome, Minimal Brain Dysfunction, Learning Disabled, Hyper-kinetic Impulse Disorder, Hyperkinetic Reaction Disorder, and Attention Deficit Disorder (ADD), either with hyperactivity or without hyperactivity (Christian, 1997; Eisenberg & Esser, 1997). Children who exhibited symptoms of ADHD prior to its classification were described as disobedient, low achieving, trouble-makers, or even just lazy. Researchers and theorists have viewed ADHD as an inability to control impulses (Barkley, 1997; Cherkes-Julkowski et al.,

1997) and a deficit in the ability to pay attention (Douglas, 1972; Greene & Barkley, 1996).

Barkley (1990) reports research in the late 19<sup>th</sup> century identified inattention and impulsivity in children, which was termed a defect in moral control. It was further discovered that inattention and impulsivity occurred in these children at an early age, with boys showing deficits in the areas of attention and impulsivity more often than girls. The research also noted that these children had a great deal of difficulty making the right decisions. It was proposed at the time that this defect in moral control could be the result of a biological event that occurred in the child's brain. Strauss and Lehtinen's study (as cited in Barkley, 1992) expanded on this belief by specifying that hyperactivity, impulsivity, and deficits in attention were the result of damage to the brain and was later defined as Minimal Brain Damage (MBD).

Douglas (1972) proposed the primary concern in children diagnosed with ADHD was a deficit in attention. Zentall (2006) described this deficit as "the failure to invest, organize, or sustain attention and effort" (p. 45). Douglas developed a treatment model around the phrase, stop, look, & listen. Children were taught to use the word stop to help reduce impulsivity, while the words look and listen were used to help focus attention toward an activity (Douglas, 1972). It was proposed the symptoms of inattentiveness and impulsivity were behind a diagnosis of ADHD in children over the symptom of hyperactivity (Barkley, 1990). Barkley (1990) noted Douglas' research as instrumental in classifying the disorder as Attention Deficit Disorder (ADD) in the DSM-III. The DSM-III was the first publication to state inattentiveness and impulsivity were primary concerns behind the disorder over hyperactivity (Barkley, 1990). The DSM-III created



diagnostic guidelines for clinicians to follow when diagnosing ADD, with or without hyperactivity. The DSM-III was later revised in 1987 renaming the disorder “Attention Deficit/Hyperactivity Disorder” (American Psychiatric Association, 1987) (ADHD).

The American Psychiatric Association again revised the criteria for ADHD in 1994 with the publication of the DSM-IV. Three subtypes of Attention Deficit/Hyperactivity Disorder were defined as follows: 1) Attention Deficit/Hyperactivity Disorder, predominantly inattentive type (ADHD-I); 2) Attention Deficit/Hyperactivity Disorder, predominantly hyperactive-impulsive type (ADHD-H); and 3) Attention Deficit/Hyperactivity Disorder, combined type (ADHD-C). As stated above, the DSM-IV defines these three subtypes of ADHD as predominantly inattentive, predominantly hyperactive-impulsive, and combined. Children diagnosed with either ADHD-I or ADHD-C show significant difficulties in the area of attention. These children often have trouble finishing assigned tasks, being able to achieve quality school work, or maintaining appropriate on-task behaviors (Davies & Witte, 2000; DuPaul & Stoner, 2003). In contrast, children diagnosed with ADHD-H do not show significant problems with attention. Children diagnosed with the predominantly hyperactive-impulsive subtype of ADHD are identified most often in children under the age of five, while children diagnosed with the predominantly inattentive subtype and the combined subtype of ADHD are identified most often in children already attending school (Barkley, 1997; DuPaul et al., 2001).

Many children diagnosed with ADHD will experience difficulty in their personal relationships. Researchers have suggested that this social difficulty will begin with parents and family members at home and later move to the school environment (Barkley,

1998; DuPaul et al., 2001; Loeber, Green, & Lahey, 1990; Pelham & Bender, 1982). Researchers believe children diagnosed with ADHD will experience poor relationships that have the potential to intensify over time if not properly treated (DuPaul et al., 2001; Ross & Ross, 1982). Barkley (1990) proposed these poor relationships can result in low academic performance and poor self-esteem. Research pointed out that many ADHD children develop a negative social pattern that is quick to develop when entering a new social situation (Bukowski & Newcomb, 1984; Pelham & Bender, 1982; Weyandt, 2001). Research also indicates that these poor relationships can develop into serious problems in adolescence and adulthood. This was supported by academic and occupational documentation, police reports, psychiatric files, and medical records (Barkley, 1998; Fisher, Harder, & Kokes, 1980; Milich & Landau, 1982; Weyandt, 2001). With ADHD affecting approximately 2 million children (Zentall, 2006), parents, teachers, and administrators are faced with the difficult challenge of finding new ways to assist children in overcoming this obstacle.

Silver (1992) reported around half the children diagnosed with ADHD will get control of the disorder by adolescence. The other half will continue to have problems through adolescence, with 30% and 70% of these children experiencing problems into their adult lives. Silver described ADHD as a life-long disability, with the symptoms of the disorder interfering in all areas of life. Weyandt (2001) also described ADHD as a lifelong condition. Biederman (1991) believed there is a serious risk of psychopathology developing as an adult if the symptoms of ADHD recognized in childhood persist through adolescence and into adulthood. Research indicates that no single intervention for children with ADHD is effective alone, due to the amount of symptoms associated

with the disorder (Muscott & Guilford, 1994). Some believe the best approach to intervention is when medication treatment is coupled with therapeutic, behavioral treatment strategies (Greene & Ablon, 2001; Hoza, 2001; Klein & Abikoff, 1997; Pelham & Gnagy, 1999).

### ***Etiology of ADHD***

It has been difficult for researchers to agree on what causes ADHD. Barkley (1991) proposed many theories have lead to the definition and diagnosis of ADHD. It is hypothesized that ADHD is a combination of genetic and environmental factors (Cherkes-Julkowski et al., 1997; Greene & Barkley, 1996). "Etiologies that are primarily genetic suggest inborn abnormalities in the structure or chemistry of the brain or in children's inherent abilities or temperaments" (Zentall, 2006, p. 39). Environmental factors are learned and expressed in social situations at home and at school, and have the ability to influence genetic factors (Zentall, 2006). Silver (1992) proposed ADHD must be addressed from what is currently understood about the disorder. As new research in the field of ADHD unfolds, it is important to develop new ideas and approaches in assisting individuals in overcoming this deficit.

### ***Genetic Explanation of ADHD***

Research indicated ADHD children will often have a family member that struggles with symptoms of the disorder (Faraone, Biederman, Krifcher, Keenan, Moore, & Ugaglia, 1992). Neurological differences have been noted between children with ADHD and children without ADHD (Barkley, 1990; Cherkes-Julkowski et al., 1997). Neuroanatomical research has identified specific areas of the brain in the regulation of attention, impulsivity, and hyperactivity (Berquin, Giedd, Jacobsen, Hamburger, Krain, &

Rapoport, 1997). Research suggests children diagnosed with ADHD have smaller anterior regions of the brain than children without ADHD (Rapoport, 1996). Recent research suggests that children diagnosed with ADHD may have problems with the biochemistry of the brain (Teicher, Anderson, Polcari, Glad, Maas, & Renshaw, 2000). Other research points to problems with neurotransmitters in the brain being a cause of ADHD (Courvoisie, Hooper, Fine, Kwock, & Castillo, 2004; Rollins, 2004), which supports the idea that ADHD could be neurologically based (Teicher et al., 2000; Weyandt, 2001). Rubia, Noorloos, Smith, & Sergeant (2003) also suggest problems in the structure of the brain to be a possible cause of ADHD. Their research hypothesized structural problems in the prefrontal area of the brain could cause deficits in motor timing, which could result in a child showing symptoms of impulsivity. This area of the brain controls the ability to make decisions and resist distractions. Other researchers agree that problems with the structure of the prefrontal area of the brain can lead to motor timing deficits that could result in impulsivity (Berquin et al., 1997). Still many researchers disagree and claim that the disorder is too complex to understand its origin (Cantwell, 1996; Erdman, 1998; Greene & Barkley, 1996; Stiefel, 1997), despite the DSM-IV stating "ADHD has been found to be more common in the first-degree biological relatives of children with ADHD" (APA, 1994, p. 82). A model that supports a neurological, genetic explanation of ADHD was defined by Barkley and explains ADHD in terms of problems in the prefrontal region of the brain.

Barkley (1997) developed a model for ADHD that identifies a deficit in behavioral inhibition as the key to understanding ADHD. The primary characteristic identified in Barkley's Inhibition Model is a deficit in response inhibition or impulsivity.

Barkley's model hypothesized that the deficit in behavioral inhibition lies with problems in the prefrontal region of the brain, which results in an ADHD child's failure to inhibit responses or in an ADHD child's impulsivity. Behavioral inhibition is the ability to manage one's behavior by directing attention to a task (Loge, Staton, & Beatty, 1990). According to Barkley (1994), a person diagnosed with ADHD does not have the ability to self-regulate behavior in specific environments. Self-regulation enables an individual to manage behavior in different environments in order to decrease inappropriate behaviors (Kern et al., 2001). Barkley's Inhibition Model (1997) focuses attention on an ADHD child's failure to stop an action over understanding what causes the excessive action. Zentall (2006) stated "the failure to inhibit contributes to three basic cognitive deficits, called executive functioning deficits: 1) the lack of internally regulated mood, motivation, and arousal; 2) the failure to analyze and synthesize new behavior; and 3) the failure to internalize speech and poor working memory" (p. 47). Strayhorn (2002) expressed that systematic programs are needed to assist ADHD children in developing skills to manage the symptoms associated with the disorder. Strayhorn's view is consistent with Barkley's view that ADHD is due to an individual not being able to manage behavior (1997).

Barkley's Inhibition Model of ADHD does not address a theoretical concept behind the deficit in self-regulated behavior. It describes differences in a primary characteristic of ADHD children (deficits in response inhibition or impulsivity) and links that characteristic to current treatments for ADHD. A prescriptive proposition by Barkley is that beginning medication at an early age, along with utilizing immediate consequences will address the concerns of ADHD. Zentall (2006) questions whether

Barkley's Inhibition Model is testable due to "a major symptom of the disability (failure to withhold responding—response disinhibition or impulsivity)" being used "to explain other symptoms and to predict treatment" (p. 48). This research lends support to continued study to identify sound programs to assist children in managing the symptoms of ADHD. If children diagnosed with ADHD are able to manage their behavior, it is possible that unwanted symptoms of ADHD would decrease resulting in on-task academic and social behavior.

### ***Environmental Explanation of ADHD***

Family environment is another area that is commonly discussed as a possible cause in the development of ADHD. Some researchers proposed that poor parenting can lead to symptoms associated with ADHD (Biederman, Faraone, Keenan, & Tsuang, 1989; Brown, Coles, Smith, & Platzman, 1991; Dadds, Sanders, & James, 1987; Taylor, Sandberg, Thorley, & Giles, 1991; Williams, Wright, & Partridge, 1999). Both hyperactivity and attention difficulties have been reported in children who are a product of a dysfunctional family environment (Cantwell, 1996). Furthermore, it has been reported that a person diagnosed with ADHD is more likely to experience psychological problems within the family than non-ADHD persons (APA, 1994). Goldstein & Goldstein (1992) reported ADHD children have a higher probability than non-ADHD children to have either siblings or parents with ADHD. Research has indicated the age and health of the mother, along with complications during pregnancy and delivery can increase the risk of ADHD (Mick, Biederman, Prince, Fischer, & Faraone, 2002). Low birth weight has also been stated as a possible reason for symptoms of ADHD to develop (Saigal, Pinelli, Hoult, Kim, & Boyle, 2003). Pennington (1991) reported between 20%

and 30% of ADHD cases are a result of environmental factors such as complications during pregnancy, maternal smoking, and maternal alcohol use. Williams et al. (1999) proposed adverse social experiences could be a reason for ADHD to develop. Biederman & Faraone (2005) reported “six risk factors in the family environment that correlated significantly with childhood mental disturbances: 1) severe marital discord; 2) low social class; 3) large family size; 4) paternal criminality; 5) maternal mental disorder; and 6) foster placement” (p. 240). Another environmental factor that has been attributed to the possible development of ADHD is associated with arousal and the amount of environmental stimulation a child receives (Zentall, 1975).

“Activity, attention, and response inhibition are symptoms of ADHD that may be consistently related to an underlying construct of arousal, which is defined as the physiological activation state of a child” (Zentall, 2006, p. 49). One theoretical model that evolved to explain how arousal relates to ADHD is Zentall’s Optimal Stimulation Theory. It proposes attention difficulties and hyperactivity can result from being in an academically under-stimulating environment (Zentall, 2006). Research by Hebb and Leuba (as cited in Zentall, 2006) hypothesized appropriate stimulation was needed for the brain to function properly. Zentall (2006) was the first to apply this concept to ADHD children in 1975. Zentall’s Optimal Stimulation Theory is grounded in the construct of arousal and proposed that ADHD children were under-aroused, under-stimulated, and overactive. Zentall proposed ADHD children need more stimulation than non-ADHD children and have a great deal of difficulty maintaining an optimal level of stimulation. Also, children with ADHD are described as more sensitive to a loss of stimulation than non-ADHD children. A later study reported non-ADHD individuals acted like



individuals with ADHD when experimentally placed in an under-stimulated environment. However, when exercise was introduced, the symptoms associated with ADHD decreased (Zentall & Zentall, 1983). If the appropriate amount of stimulation needed in a specific environmental situation is not received, a child will self-regulate that stimulation. Zentall (2006) stated the amount of stimulation available in a setting, along with learning how to self-regulate that stimulation will affect academic performance and a child's ability to control behavior. Zentall's Optimal Stimulation Theory goes a step further by suggesting alternative ways ADHD children can self-regulate stimulation other than increasing activity. Zentall's theory suggests moving focus from one thought or topic to another, along with seeking appropriate stimulation from social situations would enable ADHD children to self-regulate behavior. If ADHD children were able to appropriately self-regulate behavior through environmental stimulation, on-task behavior would increase. If on-task behavior in the classroom increases, academics would increase due to a decrease in off-task behavior.

### ***Diet and ADHD***

Some research has also pointed to poor diet as being a possible cause of ADHD. An earlier research study by Feingold (1975) pointed to food dyes, additives, and preservatives as a possible concern. Feingold, an allergist and pediatrician, designed a diet which eliminated certain additives and preservatives in food. The research was not conclusive in that only a small percentage of ADHD children improved from the diet. Another study in the same year proposed poor diet to be the reason for ADHD children to develop symptoms of hyperactivity (Smith, 1975). It was later reported that although parents may believe that sugar exacerbates the situation, there is little evidence to support



this theory (Barkley, 1990). Research reported as little as 3% to 5% of ADHD children may be sensitive to sugar and food dyes (Barkley, 1997; Whalen, 1989). More recent studies have supported the belief that an individual's diet does not cause ADHD (Weyandt, 2001; Wolraich, Wilson, & White, 1995).

Despite the debate over the etiology of ADHD, there is an agreement on the diagnostic features described in the DSM-IV. Criterion A in the DSM-IV (1994) states "the essential feature of Attention-Deficit/Hyperactivity Disorder is a persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequent and severe than is typically observed in individuals at a comparable level of development" (p. 78). Some of the symptoms that cause impairment need to be present before the age of seven (Criterion B) in at least two settings (Criterion C). There also must be documented evidence that shows interference with academic, social, and occupational functioning (Criterion D), with the disturbance not being better accounted for by another mental disorder (Criterion E). The effects of ADHD are also agreed upon, including attention difficulties, organizational problems, forgetfulness, off-task behaviors, restlessness, excessive talking, impulsivity, and frequent difficulty interrupting others (APA, 1994).

### ***Related Disorders, Impairments, and Associated Features***

The DSM-IV (2000) lists several common behaviors associated with ADHD, such as low frustration tolerance, temper outbursts, bossiness, stubbornness, excessive and frequent insistence that requests be met, mood lability, demoralization, dysphoria, rejection by peers, and poor self-esteem. It is believed that these behaviors may vary depending on the age and developmental stage of the child. In addition, children diagnosed with ADHD often experience comorbidities or coexisting conditions such as

learning disorders, auditory processing disorders, emotional problems, impairments in social functioning, academic difficulties, and deficits in self-esteem (APA, 2000; Fenstermacher, Olympia, & Sheridan, 2006; Mason, Kosterman, Hawkins, Herrenkohl, Lengua, & McCauley, 2004).

### ***Oppositional and Aggressive Symptoms***

The APA states in the DSM-IV that symptoms of Oppositional Defiant Disorder (ODD) often co-occur with symptoms of ADHD (2000). Children diagnosed with ADHD and ODD have a higher chance of developing a psychiatric disorder later in life (Speltz, McClellan, DeKlyen, & Jones, 1999). In an earlier clinical study, Stewart, Cummings, Singer, and deBois (1981) reported ADHD children that were either aggressive or oppositional could be further diagnosed with Conduct Disorder or Oppositional Defiant Disorder. Lahey, Waldman, and McBurnett (1999) stated that children with a diagnosis of ADHD and ODD have a higher risk of developing more serious anti-social behaviors. A recent study by Gadow and Nolan (2002) supports these findings and states the symptoms of ODD can possibly develop into depression, conduct disorder, and ADHD.

### ***Impairments in Social Functioning***

Many children diagnosed with ADHD have trouble interacting socially, which causes a great deal of concern for parents and teachers. Research suggests that the social problems experienced are clearly linked to key features of ADHD (DuPaul et al, 2001; Sheridan, 1998). ADHD children often have difficulty interacting with other children due to an inability to take turns and follow rules (DuPaul & Stoner, 2003). ADHD children tend to stand out in a crowd and are quickly and easily identified (Harris, Milich,

Corbitt, Hoover, & Brady, 1992). Many of these children end up being ostracized by their peers (Carlson, Lahey, Frame, & Walker, 1987). Harris et al. (1992) investigated the nature of peer rejection and found that children rejected their peers based upon either the expectation of negative behavior or the actual presence of negative behavior. This suggests that once a child establishes a history of behavioral problems associated with a diagnosis of ADHD, future changes in behavior may not result in peer acceptance. Children with serious social difficulties in childhood tend to continue having social problems later in life (Rubin, Bukowski, & Parker, 1998).

### ***Impairments in Academic Functioning***

School problems are frequently cited among children with ADHD, with research focusing on practical techniques and strategies to assist teachers and parents (Reif, 1993). It is common for ADHD children to either procrastinate and complete assignments at a slower pace or rush through assignments, making careless mistakes producing work of poorer quality (Davies & Witte, 2000). Although children with ADHD are presumed to have normal intelligence, several studies have found that children with ADHD score 7 to 15 points below their peers (Cunningham, Siegel, & Oxford, 1985; Gittelman, Mannuzza, Shenker, & Bonagura, 1985). Barkley (1988) believed this is due to a failure to comply with academic demands rather than an actual deficit in intelligence. Most teachers report that children with ADHD are viewed as underachievers; failing to complete academic assignments due to either off-task or disruptive classroom behavior (Barkley, 1988). Shapiro, DuPaul, and Bradley-Klug (1998) found children diagnosed with ADHD have a difficult time staying on task, following directions, and managing their behavioral responding. In a longitudinal study, Weiss, Hechtman, Milroy, and Perlman (1985)

found that 30% of ADHD children failed to complete high school. DuPaul and Stoner (2003) found that children with ADHD had significantly lower grade-point averages than their peers, were more often retained, had higher placement rates in special education programs, greater high school dropout rates, and a decreased enrollment in post high school academic programs.

### ***Emotional Problems***

Research has described depressive symptoms as a secondary feature of ADHD (Barkley, 1998; Hinshaw, 1994; Jensen, Shervette, Xenakis, & Richters, 1993; Zentall, 2006). Studies have indicated that depressive symptoms and anxiety frequently surface and are more common when ADHD is present (Butler, Arredondo, & McCloskey, 1995; Goldman, Genel, Bezman, & Slanetz, 1998; Lahey & Carlson, 1991; LeBlanc, 2004). Earlier research recognized restlessness, poor concentration, and emotional lability as secondary features of ADHD (Weiss, Minde, Werry, Douglas, & Nemeth, 1971). Further research by Brumbach and Weinberg (1977) noted depression as a comorbid feature among children with ADHD. Later, Brown, Borden, Clingerman, and Jenkins (1988) and Jensen, Burke, and Garfinkle (1989) supported this same finding. Biederman et al. (1989) found a high rate of mood disorder diagnosis among relatives of children with ADHD. This suggests the possibility that biology could connect mood disorders with a diagnosis of ADHD. Some researchers report that children diagnosed with ADHD and depression experience higher levels of stress than ADHD children who are not depressed, which can possibly lead to serious psychological problems (Biederman, Faraone, Milberger, Guite, Mick, & Chen, 1996; Jensen et al., 1993).

### *Deficits in Self-Esteem*

Low self-esteem is listed as a secondary feature of ADHD according to the DSM-IV (2000). Children who have difficulty controlling their behavior, and who are often told they are not listening, or doing something wrong, tend to be at risk for deficits in self-esteem. Early research found teachers' ratings of self-esteem in children with ADHD support this position (Campbell, Endman, & Bernfeld, 1977). Clinicians' evaluations of adolescents participating in a longitudinal study of ADHD listed low self-esteem as a pervasive characteristic of the disorder (Hoy, Weiss, Minde, & Cohen, 1978). Additionally, Weiss et al. (1985) noted lower self-esteem in ADHD children at an early age. A follow-up study by Weiss and Hechtman (1986) found ADHD children had more concerns with self-esteem during adolescents than their peers. Several studies support these findings (Abikoff, Ganeles, Reiter, Blum, Foley, & Klein, 1988; Goldhaber, 1991; Patterson, 1987; Slomkowski, Klein, & Mannuzza, 1995). Most believe a supportive, caring, and consistent environment is essential in the development of a child diagnosed with ADHD. Buchoff (1990) believed ADHD children would be successful in this type of environment if the child's strengths were the focus. Barkley (1998) supports building self-esteem in ADHD children through counseling and behavior modification. He believes children with ADHD may benefit from talking to a guidance counselor about ways to manage their behavior in different situations. If behavior modification is used, it is important for it to be implemented in a structured and consistent way.

### ***Assessment of ADHD***

There is no comprehensive assessment instrument to determine whether a child or adult has ADHD (McKinney, Montague, & Hocutt, 1993; National Institutes of Health, 2000). A referral to a pediatrician, family doctor, school psychologist, or guidance counselor is usually the first step in identifying the disability. It is important to gather as much information as possible from a variety of sources including psychological evaluations, parent and teacher behavior rating scales, interviews, classroom observations, computerized measures, and a medical evaluation to correctly determine a diagnosis of ADHD (Schatz, Ballantyne, & Trauner, 2001). A study by Wasserman, Kelleher, Bocian, Baker, Child, and Indacochea (1999) identified how primary care physicians (PCPs) diagnosed ADHD. According to their study, physicians relied on information gathered from parents and their children in diagnosing ADHD more than any other source available. It is important to note that only a medical professional can diagnose ADHD.

#### ***Medical, Psychological and Educational Evaluations***

Many health professionals utilize the DSM-IV in diagnosing ADHD. This publication classifies psychological disorders and is a guide for medical professionals to use in order to properly diagnose patients. The DSM-IV should only be used by a professional that has been properly trained and has experience in diagnosis. The *Wechsler Intelligence Scale for Children, Revised Edition* (WISC-R) is a psychological evaluation utilized by school psychologists in identifying ADHD. The WISC-R can assist in the diagnosis of ADHD when significantly lower scores on the three subtests of arithmetic, coding, and digit span are documented (Lufi & Cohen, 1985). Another

evaluation utilized by psychologists and school-based personnel to identify ADHD is the *Test of Variables of Attention* (TOVA), Auditory and Visual. The TOVA is a computerized assessment that is divided into an auditory test and a visual test. The TOVA, Auditory and the TOVA, Visual were developed to assess attention and impulse control (Greenberg, 2000). The TOVA is often utilized with other diagnostic assessments to gather information needed to make an accurate diagnosis.

### ***Behavior Rating Scales***

Another set of assessments used to diagnose ADHD are behavior rating scales (Barkley, 1990). Behavior rating scales are completed by parents and teachers in order to get an accurate picture of a child's functioning at home and in school (Dewey, Crawford, & Kaplan, 2003). Erk (1995) believes behavior rating scales should be one of the initial diagnostic tools utilized to identify symptoms of ADHD. There are a number of rating scales with good psychometric properties that address the characteristics of ADHD. Each scale has its own advantages and disadvantages.

The *Child Behavior Checklist* assesses a wide range of emotional and behavioral problems (Achenbach, 1991). This questionnaire is simple to complete in little time. Barkley (1990) stated the *Child Behavior Checklist* is "the most well-developed, empirically derived behavior rating scale currently available for assessing psychopathology and social competence in children" (p. 286). However, the checklist does not accurately identify hyperactivity concerns because only a few hyperactivity items are included in the scale. Results from parent and teacher checklists may vary due to the setting in which the child is observed (Barkley, 1990). The *Child Behavior Checklist* does not contain a measure of validity regarding the approach from which the

parent and teacher are completing the form. Therefore, there is no reliable way to differentiate between varying parent and teacher results in a child's behavior. Another checklist utilized in the diagnosis of ADHD is the *Conners Parent and Teacher Rating Scale*, which addresses only conduct problems, hyperactivity, and inattention (Conners, 1990). Barkley (1990) does not recommend its use for initial evaluations because of the small number of items on the rating scale and the fact that it does not assess internalizing disorders such as anxiety and depression. The *Conners Parent and Teacher Rating Scale* results will also vary due to the setting in which the child is observed. Barkley (1990) believes assessing the effects of stimulant drugs is the best use for the *Conners Parent and Teacher Rating Scale*. The *Conners Parent and Teacher Rating Scale* does not contain a measure of validity regarding the approach from which the parent and teacher are completing the form. Therefore, like the *Child Behavior Checklist*, there is no reliable way to differentiate between varying parent and teacher results in a child's behavior. The question to be addressed in interpreting the results of these rating scales is whether the varying results indicate an actual difference in behavior or are the results attributed to the perspective of the person filling out the form? The ADDES or *Attention Deficit Disorder Evaluation Scale* (McCarney, 1989) is another rating scale that parents and teachers can complete to evaluate attention concerns in children. Unfortunately the ADDES was not developed by using factor analysis or any other empirical means to validate its behavioral dimensions (Barkley, 1990).

The *Behavior Assessment System for Children* (BASC) was the first scale to adequately separate each of the characteristics necessary to differentiate between ADHD and other common childhood disorders (Reynolds & Kamphaus, 1992). Specifically, the



BASC distinguishes between ADHD, with or without hyperactivity, behavior disorders, conduct disorders, and overanxious disorders. The BASC is an integrated scale designed to diagnose a variety of emotional and behavioral disorders. It is also helpful in designing and implementing treatment plans to assist parents and teachers. The BASC's computer-generated report is based on the teacher's and parent's rating of the student's behavior. Any score in the clinically significant range identifies a serious concern in a specific area. Scores that fall in the at-risk range identify a possible concern that should be monitored. The BASC includes scales for assessing hyperactivity, inattention, conduct problems, internalizing problems, and adaptive behaviors.

### ***Treatment of ADHD***

#### ***Pharmacological Interventions***

Many children diagnosed with ADHD will benefit from prescription medication (Kollins et al., 2001; Rains & Scahill, 2006; Scahill et al., 2004). It is important for a medical doctor to assess the situation before a decision is made regarding treatment (MTA Cooperative Group, 1999). Most doctors will request information from the child's parents and school in order to make that decision. A common approach in treating ADHD is for doctors to prescribe psychotropic medication for the individual. The three categories of psychotropic medications used are stimulants, anti-depressants, and antihypertensive drugs (Connor, Fletcher, & Swanson, 1999; Zito, Safer, dosReis, Magder, Gardner, & Zarin, 1999). Research has shown pharmacological intervention is associated with higher socioeconomic status and educational level (LeFever et al., 1999).

The American Academy of Pediatrics (2001) reported stimulant medications have been prescribed for ADHD children for more than 30 years. Recent studies have reported

an increase in stimulant medication prescriptions throughout the world (Fogelman, Vinker, Guy, & Kahan, 2003; Olfson, Gameroff, Marcus, & Jensen, 2003; Zito, Safer, dosReis, Gardner, Boles, & Lynch, 2000). Methylphenidate or Ritalin is the most common stimulant medication prescribed for ADHD (Zuvekas et al., 2006). It was reported that 80% of school-age children diagnosed with ADHD are treated with stimulants (Zito et al., 1999). Stimulant medications are believed to increase dopamine and nor epinephrine levels in the brain (Spencer, Biederman, & Wilens, 2004). Silver (1992) reported that stimulants were first prescribed in 1937 by a pediatrician named Bradley. Bradley treated distractible and hyperactive encephalitis patients with the medication Benzedrine. This medication was used to decrease patients' activity level. Some studies report children are more successful when stimulants are prescribed to address the symptoms of ADHD (Kollins et al., 2001; Swanson et al., 1993). Stimulant medications are believed to help patients relax, control their anger, improve memory skills, and increase focus and concentration (Spencer et al., 2004). The primary side effects of stimulant medications are a decrease in appetite, possible weight loss, headaches, motor tics, and the inability to get a good night sleep (Rapport & Moffitt, 2002). Many doctors try and reduce or eliminate the side effects of stimulant medication by adjusting the medication dosage a patient is taking (Goldstein & Goldstein, 1992).

Another type of medication prescribed in the treatment of ADHD is antidepressants. Antidepressants can be prescribed when stimulant medications do not work. Antidepressants, like stimulant medications, work on the neurotransmitters in the brain. Tricyclic antidepressants and selective serotonin-reuptake inhibitors (SSRIs) are two specific types of antidepressants used. Unlike stimulant medications, antidepressants are

reported to take several days before seeing results (Popper, 1997). Kollins et al. (2001) noted side effects to include increased blood pressure, blurred vision, drowsiness, constipation, and dry mouth.

Antihypertensive medications are commonly prescribed by doctors to treat high blood pressure. Antihypertensive medications can also be prescribed to address the symptoms of ADHD (Biederman & Faraone, 2005; Connor et al., 1999). Clonidine is a common antihypertensive drug prescribed to address the symptoms of ADHD (Connor et al., 1999; Newcorn, Schulz, & Halperin, 2003). Scahill et al. (2004) reported decreasing ADHD symptoms with the antihypertensive medication guanfacine. Other common antihypertensive medications used are desipramine and atomoxetine (Rains & Scahill, 2006). Common side effects of antihypertensive medications include fatigue, irritability, dry mouth, and low blood pressure (Connor et al., 1999).

Some have questioned the effectiveness of medication treatment on school performance in children with ADHD (Aschenbrenner, 2006; Cohen et al., 2006; Goldstein & Goldstein, 1992; Wolraich, 2006). Some studies suggest that there is little improvement on academic performance despite the improvement in behavior (Goldstein & Goldstein, 1992; Rapport et al., 1994; Swanson et al., 1993). Others suggest there is significant improvement in academic performance, classroom functioning, and social behavior when the correct medication is used to treat ADHD (Klein, 1993; Rappley, Mullan, Alvarez, Eneli, Wang, & Gardiner, 1999; Zito et al., 2000). Abikoff and Gittleman conducted a study in 1985 to observe the behavior of 56 hyperactive children. The study divided the children into two groups. The first group consisted of 28 hyperactive children who received methylphenidate for eight weeks to see what effect the

medication would have on behavior. The second group consisted of 28 children who did not have hyperactivity concerns. The study reported both groups were indistinguishable in the areas of noncompliance and motor movement. It was reported that although the children with hyperactivity concerns had improved attention, they were still less attentive than the children that did not report hyperactivity concerns.

Rapport et al. (1994) also used methylphenidate in a study of 76 ADHD children. No significant improvement was reported in academic functioning, but there was an improvement in social interaction with the use of methylphenidate. Although 70% to 80% of ADHD children treated with medication showed some improvements in behavior, there is little research evidence showing sustained improvement in academics and socialization (Pelham, Wheller, & Chronis, 1998). This supports the belief of Whalen and Henker (1991) that any improvements noted in children diagnosed with ADHD from medication treatment are short term and do not last outside treatment parameters.

### ***Nonpharmacological Interventions***

Nonpharmacological interventions commonly utilized in the treatment of ADHD involve behavioral intervention. Some behavioral intervention techniques include positive reinforcement, modeling, behavioral rehearsal, reinforced practice, response cost, and direct instruction (Barkley, 1990; Braswell & Bloomquist, 1989; DuPaul & Stoner, 2003; Hoza, 2001; Reid & Harris, 1993; Vance & Luk, 2000). A common behavioral intervention technique labeled behavior modification uses rewards and consequences to change behavior (Coles, Pelham, & Gnagy, 2005). The MTA Cooperative Group (1999, 2000) stated behavior modification is useful in decreasing the symptoms of ADHD and should be implemented in a structured and consistent way both

at home and at school. Another intervention utilizes cognitive-behavioral strategies to teach children to recognize and manage their problem behaviors. Douglas (1972) developed a model that used cognitive-behavioral strategies to help children focus and maintain attention.

An Inattention Model of ADHD was developed by Douglas (1972) which identified the primary deficit of ADHD as the inability to sustain attention or focus on a task. Zentall (2006) described the primary deficit behind Douglas' Inattention Model of ADHD as "the failure to invest, organize, or sustain attention and effort" (p. 45). Secondary features associated with deficits in attention under this model were poor behavior, the inability to use language for self-control, and poor academic performance. Douglas and Peters (1979) later added the theoretical construct of arousal or the need for immediate reinforcement and stimulation to Douglas' Inattention Model of ADHD. This was linked to evidence suggesting ADHD children would benefit from immediate reinforcement (Zentall, 2006). Douglas developed a treatment model around the phrase "stop, look, and listen" (Douglas, 1972). Children were taught to use the word stop to help reduce impulsivity, while the words look and listen were used to help focus attention toward an activity (Douglas, 1972).

Douglas' Inattention Model of ADHD utilizes language to assist children in developing the skills necessary to strengthen attention. Cognitive-behavioral strategies teach children to develop self-control by using techniques like self-talk, self-questioning, self-monitoring, and verbal strategy rehearsal to promote positive behavior. Some researchers believe that cognitive-behavioral strategies are most helpful to an ADHD child when parents and teachers are fully invested and trained (Abramowitz & O'Leary,

1991; DuPaul & Stoner, 2003; Ervin et al., 1996). Once these behavioral interventions are put in place, it is important to maintain these processes within the child's everyday environment (Dadds et al., 1987; DuPaul & Stoner, 2003). Even with parent and teacher support, one area of concern with these types of interventions is whether or not the skills learned will carry over from the treatment condition to the child's natural environment (Ervin et al., 1996). It is proposed that teachers and parents need to meet the individual needs of each student by identifying appropriate strategies and applying them consistently (Glass, 2001).

Research has also documented that grouping ADHD children together in order to teach these strategies can sometimes lead to a decrease in desired behaviors (Ang & Hughes, 2002; Arnold & Hughes, 1999; Dishion, McCord, & Poulin, 1999). Another concern with Douglas's Inattention Model is that it is descriptive and predicts an ADHD child's problems in all situations where attention and impulse control are needed. Therefore, since most human behaviors require attention and impulse control, Douglas' Inattention Model of ADHD would not be able to predict specific conditions where ADHD symptoms would be reduced (Zentall, 2006, p. 46).

Harris, Friedlander, Saddler, Frizzelle, and Graham (2005) conducted a research study to investigate what effect the techniques of self-monitoring of attention and self-monitoring of performance had on task-oriented behavior and the spelling ability of ADHD children. Harris based this investigation on earlier research by Reid (1996), which proposed ADHD children would stay task-oriented if they were able to self-monitor their behavior.

The first independent variable, self-monitoring of performance, is defined as a technique where children are taught to focus on academic accomplishments by assessing and recording their academic performance. The second independent variable, self-monitoring of attention, is defined as a technique where children are taught to focus on increasing task-oriented behaviors by evaluating and recording attention behaviors. Task-oriented behavior was dependent variable #1, and was operationally defined as “occurring when a child 1) focused his or her eyes on the spelling list, practice paper, or self-monitoring tally sheet; 2) executed any step in the spelling study procedure; or 3) asked for help” (Harris et al., 2005, p. 150). Academic performance was dependent variable #2, and was operationally defined as the total number of times a child correctly practiced a spelling word from his or her weekly spelling list during each spelling period. The self-monitoring of performance hypothesis stated an increase in academics will develop task-oriented behaviors in ADHD children. The self-monitoring of attention hypothesis stated an increase in task-oriented behaviors will improve academics in ADHD children.

The review of literature was thorough and current; documenting how self-monitoring techniques have been utilized to increase academics and task-oriented behavior in learning disabled children; along with clearly documenting a need for classroom-based interventions that go beyond those documented by medication (Reid & Harris, 1993). The study took place in a suburban elementary school where six children who had been diagnosed with ADHD were selected for the study. The sampling method of these six children was not indicated in the study. The six children were reported by the teacher as inattentive, despite taking medication for ADHD. The children were also



reported to have severe difficulties in spelling. The children were instructed to choose five spelling words from a list of 10 commonly misspelled words to study for 15 minutes each morning. The children were taught specific steps to follow in order to learn how to spell the five words. Each child's behavior was recorded every 3 seconds by the teacher and a second trained observer to measure task-oriented behavior (dependent variable #1) during the spelling study periods. The academic performance of each child (dependent variable #2) was addressed through evaluating how each child performed in spelling the five words following the study period.

The researchers reported "the counterbalanced, multiple-baseline, across subjects design was utilized because it allows for comparisons of treatments across participants while controlling for possible confounding effects due to intervention order" (Harris et al., 2005, p. 151). The children involved in the study were randomly taught both intervention techniques in pairs, based on schedules.

In the self-monitoring of attention condition, the children involved first met with the teacher individually to discuss what paying attention means and how important it is to pay attention in class. The children were instructed to monitor and document whether their behavior was task-oriented immediately when an alarm chimed. The children were instructed to document their behavior on a check list with boxes marked yes and no. The children graphed their results by adding up the total number of times yes was checked. The children also evaluated and graphed their spelling results following the study periods.

Harris et al. (2005) reported the average task-oriented behavior (dependent variable #1) at baseline for the group of six children was 55%. During the self-



monitoring of performance condition (independent variable #1), the average task-oriented behavior for the group was 92%. During the self-monitoring of attention condition (independent variable #2), the average task-oriented behavior for the group was 94%. These results show the two techniques taught increased task-oriented behavior in each child. The average academic performance score (dependent variable #2) at baseline for the six children was 38. During the self-monitoring of performance condition (independent variable #1), the average academic performance score for the group was 83. During the self-monitoring of attention condition (independent variable #2), the average academic performance score for the group was 114. These results show the two techniques taught increased the academic performance of each child. The self-monitoring of attention condition resulted in more correct responses than the self-monitoring of performance condition, regardless of which condition was implemented first.

The results of the study show both techniques taught increased academic performance and task-oriented behavior of the six ADHD children involved. Therefore, both hypotheses were supported, with task-oriented behavior and academics improving under both conditions. Harris et al. (2005) reported the self-monitoring of attention condition improved the academic ability of the six children more than the self-monitoring of performance condition. This study warrants further investigation to find new ways to build self-monitoring skills in ADHD children. These research findings add to the body of research that previously indicated self-monitoring techniques have no affect on ADHD children.

### ***Comparing Pharmacological and Behavioral Interventions***

Diagnosing and treating ADHD remains a matter of controversy (Barkley, 1990). There have been many different interventions for the treatment of ADHD (Barkley, 1990; DuPaul & Stoner, 2003; Scahill, Carroll, & Burke, 2004). The research cited indicates medication treatment and behavioral therapy are the most common interventions used to treat the symptoms of the disorder (Greene & Ablon, 2001; Hoza, 2001; Pelham & Gnagy, 1999). Studies by MTA (1999, 2000) found medication and behavioral therapy to be effective in addressing the symptoms of ADHD, with medication being the treatment of choice. Other research supported this view (Scahill et al., 2004; Spencer et al., 2004; Swanson et al., 1993). Still other research indicated that behavioral treatment alone can be beneficial (Barkley, 1990; Braswell & Bloomquist, 1989; Cocciarella et al., 1995; DuPaul & Stoner, 2003; Gordon et al., 1991; Hoza, 2001; Reid & Harris, 1993; Vance & Luk, 2000; Wells et al., 2000). Despite evidence of some improvement in symptoms of ADHD following medication treatment, many are still concerned about the possible side effects that may arise due to the lasting effect of pharmacological treatment (Aschenbrenner, 2006; Charach et al., 2004; Cohen et al., 2006; Ervin et al., 1996; Rapport & Moffitt, 2002; Wolraich, 2006). There is also concern that medication is described by some as the cause for positive academics and behavior and a lack of medication as the cause for negative academics and behavior (Treuting & Hinshaw, 2001). Some earlier therapeutic ADHD research utilized strong, behavioral interventions in a highly controlled setting (Rapport, Murphy, & Bailey, 1980). However, the majority of behavioral treatment interventions are documented in a less structured, outpatient

setting (Horn, Ialongo, Pascoe, Greenberg, Packard, & Lopez, 1991; Klein & Abikoff, 1997; Pelham et al., 1988).

Research studies comparing pharmacological and behavioral interventions on ADHD have had conflicting results. In 1985, Gadow conducted a comprehensive review of studies comparing the effects of behavioral interventions and pharmacological treatment on the academics of ADHD and specific learning disabled (SLD) children. Gadow reported behavioral interventions had a greater effect on the academics of ADHD children and children identified as SLD than pharmacological interventions. Gadow's review of research also found little to support the belief that pharmacological treatment would enhance the positive result of behavioral interventions on academic performance.

Research in the same year studied what effect behavioral intervention and pharmacological treatment had on the reading ability of ADHD boys (Chase & Clement, 1985). Six Caucasian boys between the ages of 9 and 12, with average or above average intelligence, were referred by the Kennedy Child Study Center as subjects. These boys were identified as inattentive, hyperactive, impulsive, and as having difficulty in reading. The research questions addressed how Ritalin, self-reinforcement, and a combination of both would affect the academic performance of boys diagnosed with ADHD. Due to the lack of research available indicating psychostimulants improved academic performance (Gadow, 1983), along with positive results found from behavioral interventions indicating short-term improvements in academic performance (O'Leary, 1980), Chase and Clement (1985) conducted a direct comparison of the effects of Ritalin and self-regulation techniques on academic performance. Parental permission was obtained in order for each subject to be hired as an employee of the study. The boys received 80

cents each day they arrived at school on time and followed directions while participating in a 30-minute tutoring class. The boys were observed in a classroom setting through a one-way mirror. Every ten minutes the boys were reminded to keep working on their reading assignment while a response-cost system deducted money from their pay for aggression toward others, destruction of property, or leaving the classroom. Teacher intervention only occurred if someone was in danger of hurting themselves or someone else. Each boy received payment from a research assistant on a daily basis.

The study consisted of seven conditions utilizing different treatment combinations of medication and behavioral intervention techniques. It was reported that none of the students was taking medication prior to beginning the study. The first independent variable, Ritalin plus noncontingent reinforcers, was defined as the treatment condition where the boys were instructed to take Ritalin (5mg or 10mg) between 6:45 am and 7:00 am each morning before coming to class. The boys signed a contract with the researchers indicating it was their right whether or not to take the medication each morning. The contract stipulated payment as an employee of the study was contingent upon taking the medication each morning, along with bringing a signed parental form certifying that the medication was taken. During the Ritalin plus noncontingent reinforcers condition, the boys picked pieces of paper from a box at the end of each session. The pieces of paper were numbered with points administered by the boys in the self-reinforcement condition. The boys did not know how the points were determined, only that the points could be later exchanged for reinforcement. The second independent variable, self-reinforcement plus drug placebo, was defined the same as the Ritalin treatment condition, except the medication taken each morning was a placebo. Also, for this treatment condition, each

boy was trained individually to self-document his performance on reading questions given. Before running the self-reinforcement treatment condition, each boy determined the number of reading questions he would answer each day. The goal was recorded and monitored each day to determine if it was being met. The third independent variable, Ritalin plus self-reinforcement, was defined the same as the self-reinforcement plus placebo condition, except the medication given each morning was Ritalin.

The first dependent variable was defined as whether each boy appropriately used the wrist counter to document answering each reading question. The second dependent variable was defined as the number of comprehension questions answered each day by the student. The third dependent variable was defined as the number of comprehension questions answered correctly divided by the number of questions answered each day by the student.

The review of literature was thorough and supported the position that psychostimulants have not shown significant academic improvement in ADHD children (Gadow, 1983), along with documenting short-term academic success in ADHD children following behavioral interventions (O'Leary, 1980). The concern of medication being used as the primary treatment was documented (Schechter, 1982) and continues to be supported in research today (Aschenbrenner, 2006; Cohen et al., 2006; Goldstein & Goldstein, 1992; Wolraich, 2006), despite improvements seen in behavior (Charach et al., 2004; Goldstein & Goldstein, 1992; Rapport, et al., 1994; Swanson et al., 1993). Specifically, research in the area of self-regulation was documented and encouraged further investigation on how to teach ADHD children to self-control behavior (Rosenbaum & Drabman, 1979). Chase and Clement based their study on earlier

research by Anderson, Clement, and Oettinger (1981), which compared the effects of Ritalin and training in self-control on ADHD children. The study found Ritalin to be more effective in the treatment of ADHD than training in self-control. Chase and Clement (1985) noted “the investigators failed to ensure that the children actually carried out the prescribed self-control procedures when they were working in the classroom” (p. 324). Also, it was noted that Anderson et al. (1981) did not include a daily measure of academic performance in order to determine the immediate effects of each treatment. This led Chase and Clement to question their findings and further investigate the effects of Ritalin and self-regulation on ADHD children.

Research assistants collected data behind a one-way mirror during the daily 30-minute tutoring session. It was reported the research assistants demonstrated 99% interobserver agreement during the course of the investigation, along with 100% interscorer agreement. Researchers correlated daily scores for accuracy of academic performance across all subjects during the self-reinforcement condition,  $r = -0.03$  and the Ritalin plus self-reinforcement condition,  $r = 0.18$ . According to Chase and Clement (1985), these reported low correlations for accuracy of academic performance across all subjects suggested independence between two of the measures of treatment effect. The researchers also recorded compliance with self-regulation through the signed parental permission form which indicated each subject had taken their pill each morning before school.

Chase and Clement (1985) reported that Ritalin alone (independent variable #1) did not improve the academic performance of ADHD children. This report is consistent with recent findings documenting medication alone does not positively affect academic

performance in ADHD children without the adverse risks associated with medication (Aschenbrenner, 2006; Charach et al., 2004; Cohen et al., 2006; Goldstein & Goldstein, 1992; Rapport et al., 1994; Swanson et al., 1993; Wolraich, 2006). The study also reported, during the Ritalin treatment condition, all six boys stopped answering reading questions 88% of the time. Chase and Clement (1985) stated this finding is reason enough to investigate if Ritalin caused the boys to stop answering reading questions. It was determined a drug-placebo-alone condition should have been included to determine whether some extraneous variable had produced the response suppression during the drug-alone condition.

The self-reinforcement treatment condition (independent variable #2) was reported to improve the academic performance of ADHD children. Five out of the six boys or 83% improved their reading ability during self-reinforcement. This finding is consistent with recent studies stating self-regulation techniques improve the academics of ADHD children (DuPaul & Stoner, 2002; Reid, 1996).

An improvement in academics was also seen in the Ritalin plus self-reinforcement treatment condition (independent variable #3). Chase and Clement (1985) reported Ritalin and self-reinforcement improved the academics of ADHD children over self-reinforcement alone and self-reinforcement improved the academics of ADHD children over Ritalin alone. Therefore, the study determined that pharmacological treatment alone did not improve the reading ability of boys diagnosed with ADHD. The reading ability of boys diagnosed with ADHD improved when self-reinforcement was implemented. It was also noted that when self-reinforcement was combined with Ritalin, the improvement in academics was more evident.

The results from both Chase and Clement (1985) and Gadow (1985) showed behavioral interventions had a greater impact on the academic ability of ADHD children than medication alone. More recently, the MTA investigated the effectiveness of pharmacological treatment and behavioral interventions on the symptoms of ADHD children (1999). The study concluded that behavioral intervention techniques were less effective than pharmacological treatment in addressing the symptoms of ADHD. The American Academy of Pediatrics (2001) reported that physicians tend to favor medication treatment over behavioral techniques in addressing the symptoms of ADHD. A review on the treatment of ADHD found similar results (Miller, Lee, Raina, Klassen, Zupancic, & Olsen, 1998). Most research suggests a combination of medication and behavioral intervention strategies will show a greater effect on ADHD symptoms than medication or behavioral strategies alone (Gadow, 1985; Klein, 1997). However, these strategies have not shown sufficient long-term benefits related to improved academics and improved social development (DuPaul & Stoner, 2003; Purdie et al., 2002).

### ***Music as an Intervention***

Throughout history music has been used to celebrate, to mourn, to relax, to motivate, to ease depression, and to manage psychiatric illness (Covington, 2001). Campbell (2000), a classically trained musician and author of *The Mozart Effect for Children: Awakening Your Child's Mind, Health and Creativity with Music*, believes that music enhances the social, emotional, physical, and cognitive growth of a child. Campbell (2000) stated that music is "a key we give them (children) to unlock their minds, bodies, and hearts" (p. 119). Music has the power to elicit many different emotions. It can assist with relaxation, help clear the mind, build excitement, heighten



the feeling of happiness, and bring tears when feeling sad. Music can relax as well as excite. Covington (2001) reported music therapy as effective in treating psychiatric disorders. Music was also reported to decrease chronic pain perception when paired with an attention enhancement strategy (Hong, 1996). Despite its therapeutic effect, there is little research related to the use of music in addressing the symptoms of ADHD. More specifically, there is little research about the effect music has on an ADHD child's behavior and ability to learn. However, Howard Gardner's Theory of Multiple Intelligences named music as one of the eight recognized intelligences and proposed its use to engage children in the classroom (Gardner, 1993).

Early research by Wilson (1976) used rock music and a time-out intervention technique to decrease disruptive behavior in children. Another study by Cripe (1986) reported using background music to reduce hyperactivity in children. Shehan (1981) reported an increase in a child's ability to retain information by pairing background music with visual cues. Background music has also been reported to increase appropriate on-task behavior in children (Simpson, 1976). In a study conducted by Morton, Kershner, and Siegel (1990), music was reported to enhance the effect of dichotic listening, which is the simultaneous stimulation of the right and left ear by different sounds. The study indicated that dichotic listening could result in an ability to process information correctly without distraction, thus increasing short-term memory. In 1998, Montello and Coons studied the effect group music therapy had on students with academic and behavior problems. The study found that students had overall improvements in the areas of attention, motivation, and aggression after participating in the music therapy intervention technique.

Music was used in another study to investigate its effect on student behavior in a school cafeteria (Chalmers, Olson, & Zurkowski, 1999). The study utilized a decibel meter to record the noise level of students in the cafeteria while documenting the number of interventions by school staff necessary due to behavioral issues. Researchers recorded the interventions along with the noise level in 5 minute intervals. The research study recorded data from 20 lunch periods lasting approximately 25 minutes in length. Three conditions were introduced during the lunch periods. The first condition introduced was to play classical piano music on a portable tape player. The second condition was what the researchers called a no-music condition, where data was recorded while no music was being played in the cafeteria. The third condition introduced popular radio music with slow to moderate tempos in order to simulate the classical piano music played in the first condition. Researchers documented baseline data over five lunch periods to record the number of interventions by school staff necessary due to behavioral issues along with the noise level in the cafeteria. Their results showed that when the no-music condition was implemented, the noise level remained relatively the same. When the classical piano music was introduced, the noise level decreased by 6 decibels, or 7%. When the popular radio music was introduced, the decrease was even greater at 10 decibels, or 12% below the no-music condition. The interventions necessary by school staff due to behavioral issues were recorded at 20 per period, or approximately 1 per minute during the no-music condition. During both conditions where music was introduced, the interventions necessary due to behavioral issues were recorded at 7 per period, or 1 every 3 minutes. This resulted in a 65% decrease in cafeteria interventions due to behavior issues. Following the study, researchers surveyed students and found 103 out of 116 (88.8%)

liked music during lunch, with the majority preferring popular radio music over classical piano music.

Jackson (2003) researched how music therapy was employed in elementary schools to assist ADHD children. Jackson surveyed 500 board-certified music therapists. A total of 268 (54% response rate) therapists responded to the experimenter-designed questionnaire, and 98 of them reported working with children diagnosed with ADHD. Among these 98 therapists, Jackson found the following: 1) music and movement was indicated as a therapy method by 74%; 2) instrumental improvisation was indicated as a therapy method by 67%; 3) musical play was indicated as a therapy method by 63%; and 4) group singing was indicated as a therapy method by 55%. The questionnaire results documented 94% surveyed indicated addressing behavioral goals the most, psychosocial goals were indicated as being addressed by 89%, and cognitive goals were indicated as being addressed by 69%. The questionnaire results also indicated that 41% of music therapists surveyed treated ADHD children in both individual and group settings, thirty-nine percent of music therapists surveyed treated ADHD children in a group setting only, and twenty percent of music therapists surveyed treated ADHD children individually. The researchers concluded that music therapy was viewed as effective according to the feedback music therapists received from teachers, parents, and children involved, along with the treatment outcomes set by the therapist and student.

A recent experimental study by Rickson (2006) investigated the effect of music therapy on the symptom of impulsivity in boys diagnosed with ADHD. An experimental control group design was developed along with different treatment interventions. Rickson (2006) hypothesized there would be no statistically significant difference

between instructional music therapy and improvisational music therapy on the symptom of impulsivity in boys diagnosed with ADHD.

Rickson (2006) used a Synchronized Tapping Task (STT) and the *Conners Behavior Rating Scale* as a measure of impulsivity. The students involved were divided into three groups: 1) Group A (n = 5); 2) Group B (n = 4); and 3) Group C (n = 4). Group A was labeled the control group and did not receive music therapy treatment until after the study was complete. Group B and Group C received 8 sessions of instructional music therapy and 8 sessions of improvisational music therapy. During phase 1 of the study, Group B received improvisational music therapy, while Group C received instructional music therapy. During phase 2, both groups received the opposite music therapy as treatment. The interventions implemented in the study utilized percussion instruments.

In the instructional session, which was labeled independent variable #1, the boys were instructed to pick a percussion instrument in order to echo back the beats played by the music therapist. This technique is defined as call and response (Schmid, 1998). The format of the intervention was highly structured and repetitive, utilizing simple rhythms, and concluded with a percussion ensemble. The instructional session was designed and implemented based on the idea that ADHD children perform better in a highly structured environment (Barkley, 1998). The therapist took on a leadership role during the instructional session of the study. The boys were given constant direction, encouragement, and praise throughout the session.

In the improvisation session, which was labeled independent variable #2, the boys were asked to pick a percussion instrument, along with a musical style, a mood, or a

theme to be employed by the group during improvisation. The music therapist used cue cards to assist the boys in choosing a musical style, a mood, or a theme for improvisation. The cue card selection for musical style included "Country, Rap, Blues, Rock, Ballad, and Jazz" (Rickson, 2006, p. 42). The cue card selection for mood included "Happy, Sad, Bored, Excited, Angry, and Calm" (Rickson, 2006, p. 42). The cue card selection for theme included "The Train, The Forest, The Fairground, The Beach, Car Racing, and School" (Rickson, 2006, p. 42). The improvisation session also resulted in the group playing a percussion ensemble. During the improvisation session, there was little verbal input from the therapist regarding the drumming ability of the boys. The therapist encouraged and supported the boys musically through the drumming session. The improvisation session was based on findings where music therapy was delivered with reported success in a non-structured creative fashion (Haines, 1989; Robbins & Robbins, 1991), despite the belief by some that non-structured creative music environments may over-stimulate ADHD children (Rickson & Watkins, 2003) resulting in off-task behavior.

A computerized test called a Synchronized Tapping Task (STT) was used as a measure of impulsivity. "The computerized test measured each student's ability to activate a single switch simultaneously with a woodblock sound emitted from the computer at durational intervals of 1500 milliseconds (ms) or 40 beats-per-minute (bpm), and also at 800 ms or 75 bpm" (Rickson, 2006, p. 42). The boys were instructed keep a simultaneous beat with the computer by clicking the computer switch at the same time that the computer sounded a beat. Rickson gathered baseline data on 4 days over a two week period prior to beginning the music therapy intervention. The boys received the STT at each speed (1500 ms and 800 ms) on each of the 4 days. Group B and Group C

were tested before and after the music therapy interventions, at each speed, to determine if the music intervention was increasing arousal levels. The *Conners Behavior Rating Scale* was utilized to measure impulsivity. The *Conners Rating Scale* is based on parent and teacher input.

Rickson (2006) conducted a three-way analysis of variance (ANOVA) set at the  $p = <.05$  level to determine that there were no significant group differences at the beginning of the study. Unpaired  $t$ -tests were conducted to compare instructional and improvisational music therapy approaches. Rickson (2006) did not find a difference statistically between instructional and improvisational music therapy approaches as they related to levels of motor impulsivity in adolescent ADHD boys ( $p = .250$ ). However, the two experimental groups did show non-statistically significant reduced STT scores after the instructional session was delivered. The study also showed a small, non-statistically significant improvement in parent and teacher responses relating to impulsivity on the *Conners Behavior Rating Scale*. This small improvement suggests the need for further study in this area.

Music therapists reported students diagnosed with ADHD display disordered beating and were not able to keep rhythm due to poor impulse control (Frisch, 1990; Hong, Hussey, & Heng, 1998; Perilli, 1995). Research has documented motor timing impairments in relation to a diagnosis of ADHD (Barkley, 1998; Smith, Taylor, Rogers, Newman, & Rubia, 2002). It is believed making music involves self-control, paying attention, and focusing on one's surroundings. There is also an agreement that rehearsal involving a steady beat will capture an ADHD child's attention leading to improved organizational skills, better impulse control, and improved awareness of one's self (Bunt

& Hoskyns, 2002; Howell, Flowers, & Wheaton, 1995; Wigram, Pederson, & Bond, 2002).

### **Theoretical Framework for the Study**

Based on the review of ADHD related theoretical and empirical research, three theoretical models emerge emphasizing one primary characteristic affecting multiple areas of functioning: 1) Douglas' Inattention Model; 2) Zentall's Optimal Stimulation Theory; and 3) Barkley's Inhibition Model. "These theoretical models describe differences in a primary characteristic of children with ADHD" (Zentall, 2006, p. 45). Douglas' Inattention Model (1972) emphasized the primary concern in children diagnosed with ADHD was a deficit in attention, Zentall's Optimal Stimulation Theory (1975) focused on arousal as the primary concern behind the diagnosis of ADHD, while Barkley's Inhibition Model (1997) emphasized response inhibition or impulsivity as the primary characteristic of ADHD. Despite each theoretical model naming different primary characteristics behind ADHD, there is a common focus in treatment. Each theoretical model points toward building self-regulating or self-monitoring techniques in ADHD children. Self-regulating or self-monitoring techniques are a way for students to manage their behavior in different environments in order to decrease inappropriate behaviors (Kern et al., 2001, Reid, Trout, & Schartz, 2005; Reis, 2002).

Douglas' Inattention Model (1972) emphasized the primary concern in children diagnosed with ADHD was a deficit in attention. Zentall (2006) described this deficit in attention as "the failure to invest, organize, or sustain attention and effort" (p. 45). Douglas and Peters (1979) later added impulsivity to the model due to evidence suggesting arousal deficits and the positive effects of increased stimulation in children

diagnosed with ADHD. Secondary features associated with deficits in attention under this model were poor behavior, the inability to use language for self-control, and poor academic performance. Douglas (1972) developed a treatment model around the phrase stop, look, and listen. Children were taught to use the word stop to help reduce impulsivity, while the words look and listen were used to help focus attention toward an activity. The World Music Drumming technique of call and response instructs the students to use Douglas' stop, look and listen technique. Students are instructed to stop what they are doing in order to look and listen to the beats played by the drum circle leader. These beats are then echoed back by the students utilizing the call and response technique. In this model, attention is proposed to improve due to training students to look and listen to the beats being played, while training students to stop what they are doing in order reduce impulsivity.

“Activity, attention, and response inhibition are symptoms of ADHD that may be consistently related to an underlying construct of arousal, which is defined as the physiological activation state of a child” (Zentall, 2006, p. 49). Zentall's Optimal Stimulation Theory proposed attention difficulties and hyperactivity can result from being in an academically under-stimulating environment and is grounded in the construct of arousal. Zentall (1975) proposed ADHD children need more stimulation than non-ADHD children and have a great deal of difficulty maintaining an optimal level of stimulation. Also, children with ADHD are described as more sensitive to a loss of stimulation than non-ADHD children. If the appropriate amount of stimulation needed in a specific environmental situation is not received, a child will self-regulate that stimulation. Zentall (2006) stated the amount of stimulation available in a setting and



learning how to self-regulate that stimulation will affect academic performance and a child's ability to control behavior. Zentall's Optimal Stimulation Theory goes a step further by suggesting alternative ways ADHD children can self-regulate stimulation other than increasing activity. It is proposed that moving focus from one thought or topic to another, along with seeking appropriate stimulation from social situations will enable ADHD children to self-regulate behavior. If ADHD children were able to appropriately self-regulate behavior through environmental stimulation, it is suggested that on-task behavior would increase. If on-task behavior in the classroom increases, it is suggested that academics would increase due to a decrease in off-task behavior

Barkley's Inhibition Model (1997) stated a deficit in response inhibition was the key to understanding ADHD. Barkley proposed this deficit in response inhibition is due to problems in the prefrontal region of the brain, resulting in a failure to inhibit responses, or impulsivity. Behavioral inhibition is defined as the ability to control one's behavior by directing attention to a task (Loge et al., 1990). Barkley proposed that a person diagnosed with ADHD does not have the ability to self-regulate behavior in specific environments (Barkley, 1994). Self-regulation is a way for students to manage their behavior in different environments in order to decrease inappropriate behaviors (Kern et al., 2001). Barkley's Inhibition Model (1997) emphasizes an ADHD child's failure to stop an action over understanding what causes the excessive action. Zentall (2006) reported "the failure to inhibit contributes to three basic cognitive deficits, called executive functioning deficits: 1) the lack of internally regulated mood, motivation, and arousal; 2) the failure to analyze and synthesize new behavior; and 3) the failure to internalize speech and poor working memory" (p. 47). It is proposed that these executive

functioning deficits explain an ADHD child's inability to conceptualize time and self-regulate behavior (Zentall, 2006).

Based on the theories and models cited above, the proposition to be tested in this study suggests the making of steady beats of music while participating in structured drum circle activities will teach the students involved to self-regulate their behavior, which will result in improved impulse control and increased concentration skills. Specifically, it is proposed that compared to second through fifth grade students with attention difficulties who do not participate in the seven-week World Drumming Music program, second through fifth grade students with attention difficulties who participate in the seven-week World Drumming Music program will have significant decreases in their TOVA auditory skills test percentage of error scores and their TOVA visual skills test percentage of error scores.

The hypotheses in this study set out to test these propositions and lend support to past research and theories related to music as a nonpharmacological intervention in the treatment of ADHD by proposing a relationship between World Music Drumming and attention skills in elementary school students. In addition to the hypotheses, the research questions were developed to investigate whether there is a relationship between student characteristics and their TOVA pre-test and post-test auditory and visual attention skills.

### **Research Questions**

1. What are the gender, age, estimated grade level, and BASC classifications of the second through fifth grade students with attention difficulties who participated in this study?

2. What are the pre-test and post-test TOVA auditory and visual skills test percentage of error scores and response time scores of the second through fifth grade students with attention difficulties who participated in this study?
3. What is the relative contribution of the gender, age, estimated grade level, and BASC classification of second through fifth grade students with attention difficulties in explaining their auditory and visual TOVA scores?

### **Hypotheses**

- H1 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of error scores.
- H<sub>1a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of commission (impulsivity) error scores.
- H<sub>1b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of omission (inattention) error scores.
- H2 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of error scores.
- H<sub>2a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have

a significant decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores.

H<sub>2b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of omission (inattention) error scores.

H3 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA response time scores.

H<sub>3a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test response time scores.

H<sub>3b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test response time scores.

H4 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of error scores.

H<sub>4a</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not

have a significant decrease in their TOVA auditory skills test percentage of commission (impulsivity) error scores.

H<sub>4b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of omission (inattention) error scores.

H5 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test percentage of error scores.

H<sub>5a</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores.

H<sub>5b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test percentage of omission (inattention) error scores.

H6 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA response time scores.

H<sub>6a</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not

have a significant decrease in their TOVA auditory skills test response time scores.

H<sub>6b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant increase in their TOVA visual skills test response time scores.

H7 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test percentage of error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

H<sub>7a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test percentage of commission (impulsivity) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

H<sub>7b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test percentage of omission (inattention) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

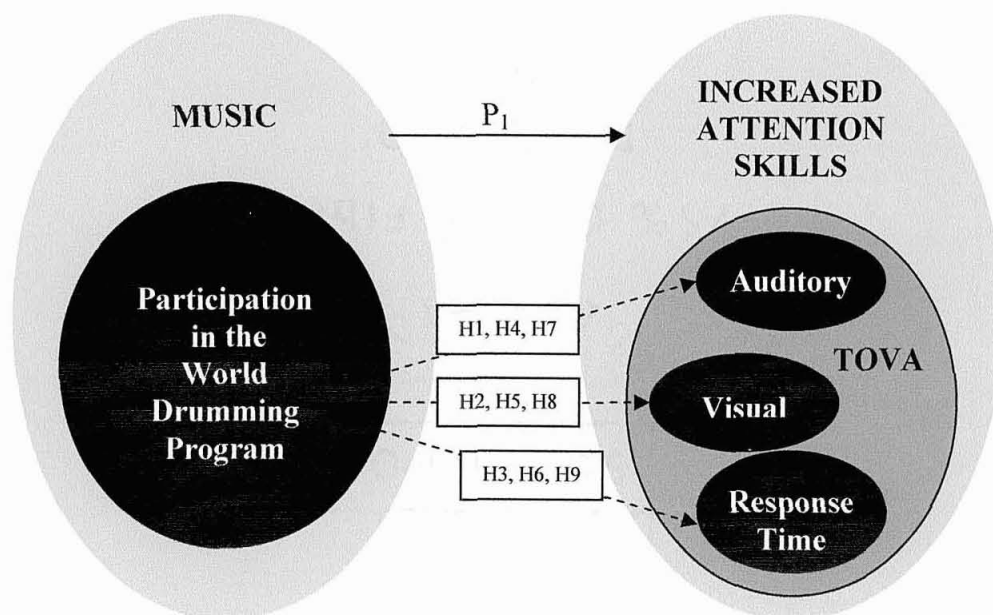
- H8 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.
- H<sub>8a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.
- H<sub>8b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of omission (inattention) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.
- H9 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

H<sub>9a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

H<sub>9b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

Figure 2-1 is a model of the hypothesized relationship between music and increased attention skills. H1, H4, and H7 test the relationship between participation or no participation in the world music drumming program and decreases in TOVA auditory (commission and omission) skills test percentage of error scores. H2, H5, and H8 test the relationship between participation or no participation in the world music drumming program and decreases in TOVA visual (commission and omission) skills test percentage of error scores. H3, H6, and H9 test the relationship between participation or no participation in the world music drumming program and decreases in TOVA auditory and visual skills test response time scores.





*Figure 2-1.* Model of the hypothesized relationship between music and increased attention skills.

Chapter II consisted of a review of the literature and established the theoretical framework leading to the hypotheses and research questions to be analyzed in this study. The areas in the review of literature that need further investigation consist of the following: 1) the effects of medication on academic performance in children with attention difficulties have been questioned (Aschenbrenner, 2006; Cohen et al., 2006; Goldstein & Goldstein, 1992; Wolraich, 2006); 2) despite evidence of some improvement in symptoms of ADHD following medication treatment, many are still concerned about the possible side effects that may arise due to the lasting effect of pharmacological treatment (Charach et al., 2004; Ervin et al., 1996); and 3) there are a limited number of nonpharmacological, education-based interventions to assist children with attention difficulties in overcoming their disability. This study was designed to

address both concerns associated with medication being used as the primary treatment for ADHD children, along with the lack of evidence showing academic improvement in ADHD children following medication treatment. This study is significant because it attempts to use World Music Drumming as treatment to build attention skills in children with attention difficulties instead of addressing their attention difficulties with medication treatment. This study may improve future research by providing a tested nonpharmacological education-based intervention program to be used in schools to assist children with attention difficulties in overcoming their disability. It is suggested by this researcher that further study in the area of behavioral intervention is needed in order to determine the effectiveness of such treatment.

Chapter III presents the methodology of the research study used in answering the research questions and testing the hypotheses for this study about the effect of a drumming intervention on the auditory and visual attention skills of students with attention difficulties.

## **CHAPTER III**

### **RESEARCH METHODS**

Chapter III describes the research methods used in this study about the effect of World Music Drumming on the auditory and visual attention of students identified with attention difficulties at a South Florida elementary school. The research questions and hypotheses in this study evolved from the review of literature, which suggested a need to investigate a nonpharmacological education-based intervention program to improve attention in children with attention difficulties. Attention disorders, occurring in 5% to 10% of children are usually referred because of hyperactivity. Yet, only half of children with attention disorders are hyperactive (Scahill et al., 2004). For this reason, this study focused on children with at-risk and clinically significant attention scores identified by the Behavior Assessment System for Children (BASC). Chapter III discusses the design of the study, the population, the sampling methods used, the setting in which the study took place, the instruments used, the ethical considerations related to data collection procedures, the methods of data analysis, and an evaluation of the research methods.

#### **Research Design**

The research questions and hypotheses stated in Chapter II led to the development of a quantitative, causal-comparative, explanatory experimental study. A true experimental research design was chosen because the purpose of the study was to examine the effect of World Music Drumming on the auditory and visual attention of students identified with attention difficulties at a South Florida elementary school, for the purpose of looking for a causal relationship between drumming and attention. It was

hypothesized that auditory and visual attention skills will increase among those students who participated in the intervention.

The strongest experimental research design is comprised of a sample randomly assigned to an experimental group and a control group, which are given a pre-test and a post-test measure in order to determine what effect an independent variable has on a dependent variable (Babbie, 2001). This study utilized these three pairs of components to examine what effect the independent variable (participation in World Music Drumming program) had on the dependent variables (auditory and visual attention). The instrument used as a pre-test and post-test measure was the *Test of Variables of Attention* (TOVA), Auditory and Visual. Figure 3-1 shows the randomly assigned, two-group pre-post test design. The first line depicts the randomly assigned (R) experimental group being administered the TOVA, Auditory and Visual as a pre-test ( $O_1$ ), followed by World Music Drumming as treatment (X), followed by the administration of the TOVA, Auditory and Visual as a post-test ( $O_2$ ), concluding with the difference between the TOVA, Auditory and Visual post-test ( $O_2$ ) and the TOVA, Auditory and Visual pre-test ( $O_1$ ). The second line depicts the randomly assigned (R) control group being administered the TOVA, Auditory and Visual as a pre-test ( $O_1$ ), followed by no treatment intervention, followed by the administration of the TOVA, Auditory and Visual as a post-test ( $O_2$ ), concluding with the difference between the TOVA, Auditory and Visual post-test ( $O_2$ ) and the TOVA, Auditory and Visual pre-test ( $O_1$ ).

R	$O_1$	X	$O_2$	$=$	$O_2 - O_1$
R	$O_1$		$O_2$	$=$	$O_2 - O_1$

*Figure 3-1. Randomly assigned two-group pre-post test design.*

The **dependent variables** in this study were auditory and visual attention skills. Auditory attention was measured by TOVA auditory scores from students identified with at-risk or clinically significant BASC classifications in the area of attention. Visual attention was measured by TOVA visual scores from students identified with at-risk or clinically significant BASC classifications in the area of attention. This study also identified the difference between TOVA auditory and visual pre-test and post-test scores.

The **independent variable** in this study was the participation in the World Music Drumming program. World Music Drumming is a cross-cultural curriculum that meets current standards for music education and teaches children how to work together while respectfully communicating with each other through a drum circle activity (Schmid, 1998). Participation in World Music Drumming was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The **attribute variables** of gender, age, estimated grade level, and BASC classification were also analyzed to see if they had an effect on auditory and visual attention.

Three **research questions** were explored in this study. The first research question, about the gender, age, estimated grade level, and BASC classification of the

second through fifth grade students with attention difficulties who participated in this study was answered using frequency distributions and measures of central tendency to describe the characteristics of each student in the research study. The second research question, about the pre-test and post-test TOVA auditory, visual, and response time scores of the second through fifth grade students with attention difficulties who participated in this study was answered using frequency distributions and measures of central tendency to describe each student's TOVA pre-test and post-test scores in terms of errors of omission, errors of commission, and response time scores, including the difference between the pre-test and post-test. For the third research question, about the relative contributions of gender, age, estimated grade level, and BASC classifications of second through fifth grade students with attention difficulties in explaining their TOVA scores, the dependent variables were the student's TOVA auditory and visual scores. Separate analyses were conducted for commission errors, omission errors, response time, and response time difference, and were measured by each student's TOVA pre-test and post-test. The attribute variables were the student's reported gender, age, estimated grade level, and BASC classification. Multiple regression analysis was used to answer the third research question by testing for the relative contribution of each student characteristic on TOVA scores. Figure 3-2 shows the variables involved in answering the three research questions.

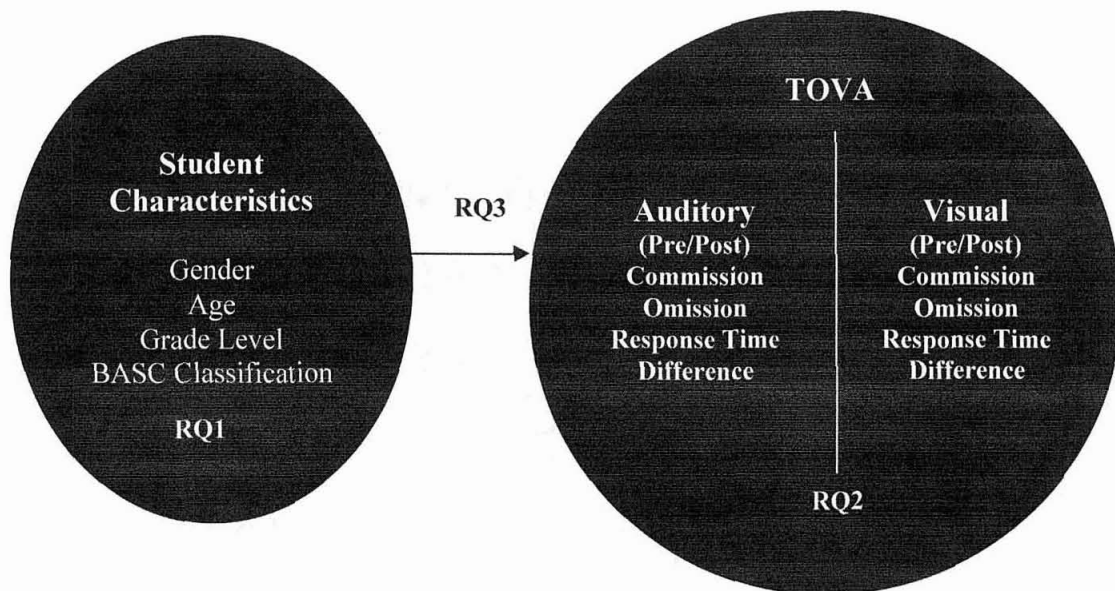


Figure 3-2. Variables involved in answering the research questions.

Nine **hypotheses** were tested in this study. For the first hypothesis, about the second through fifth grade students with attention difficulties who participated in the World Music Drumming intervention having a significant decrease in their TOVA auditory skills test percentage of error scores, the independent variable was participation in the World Music Drumming program and was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was auditory attention skills, measured by commission errors ( $H_{1a}$ ) and omission errors ( $H_{1b}$ ) on the TOVA, Auditory.

For the second hypothesis, about the second through fifth grade students with attention difficulties who participated in the World Music Drumming program having a significant decrease in their TOVA visual skills test percentage of error scores, the independent variable was participation in the World Music Drumming program and was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was visual attention

skills, measured by commission errors ( $H_{2a}$ ) and omission errors ( $H_{2b}$ ) on the TOVA, Visual.

For the third hypothesis, about the second through fifth grade students with attention difficulties who participated in the World Music Drumming intervention having a significant decrease in their TOVA auditory and visual skills test response time scores, the independent variable was participation in the World Music Drumming program and was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was response time skills, measured by the response time on the TOVA, Auditory ( $H_{3a}$ ) and Visual ( $H_{3b}$ ).

For the fourth hypothesis, about the second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program not having a significant decrease in their TOVA auditory skills test percentage of error scores, the independent variable was not participating in the World Music Drumming program and was defined as no involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was auditory attention skills, measured by commission errors ( $H_{4a}$ ) and omission errors ( $H_{4b}$ ) on the TOVA, Auditory.

For the fifth hypothesis, about the second through fifth grade students with attention difficulties who did not participate in the World Music Drumming intervention not having a significant decrease in their TOVA visual skills test percentage of error scores, the independent variable was not participating in the World Music Drumming program and was defined as no involvement in the drum circle activities as treatment for



30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was visual attention skills, measured by commission errors ( $H_{5a}$ ) and omission errors ( $H_{5b}$ ) on the TOVA, Visual.

For the sixth hypothesis, about the second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program not having a significant decrease in their TOVA auditory and visual skills test response time scores, the independent variable was not participating in the World Music Drumming program and was defined as no involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was response time skills, measured by the response time on the TOVA, Auditory ( $H_{6a}$ ) and Visual ( $H_{6b}$ ).

The seventh hypothesis, about the second through fifth grade students with attention difficulties who participated in the World Music Drumming program having a significantly greater decrease in their TOVA auditory skills test percentage of error scores than the second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program, the independent variable was participation in the World Music Drumming program and was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was auditory attention skills, measured by commission errors ( $H_{7a}$ ) and omission errors ( $H_{7b}$ ) on the TOVA, Auditory.

The eighth hypothesis, about the second through fifth grade students with attention difficulties who participated in the World Music Drumming program having a significantly greater decrease in their TOVA visual skills test percentage of error scores

than the second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program, the independent variable was participation in the World Music Drumming program and was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was visual attention skills, measured by commission errors (H<sub>8a</sub>) and omission errors (H<sub>8b</sub>) on the TOVA, Visual.

The ninth hypothesis, about the second through fifth grade students with attention difficulties who participated in the World Music Drumming program having a significantly greater decrease in their TOVA auditory and visual skills test response time scores than the second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program, the independent variable was participation in the World Music Drumming program and was defined as involvement in the drum circle activities as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions). The dependent variable was response time skills, measured by response time on the TOVA, Auditory (H<sub>9a</sub>) and Visual (H<sub>9b</sub>).

## **Population and Sampling Plan**

### ***Target Population***

The target population consisted of second through fifth grade students with attention difficulties who attend a South Florida elementary school. Based on past research, it has been estimated between 8% and 20% of school-age children exhibit behaviors that could lead to a diagnosis of ADHD; with 3% to 7% of those children manifesting behaviors severe enough to need services (Shaywitz & Shaywitz, 1997). It is believed that up to two million children are diagnosed with ADHD today (Zentall,

2006). Research suggested that boys are identified and diagnosed with ADHD more often than girls; four boys to every one girl (August et al., 1996; Wolraich et al., 1996, 1998). Therefore, it is estimated that 48 to 120 (8% to 20%) of the 600 second through fifth grade students at a South Florida elementary school would exhibit behaviors that could lead to a diagnosis of ADHD, along with 18 to 42 (3% to 7%) of the 600 second through fifth grade students at a South Florida elementary school could manifest behaviors severe enough to need services.

### ***Eligibility Criteria***

1. Eligible students included the estimated 48 to 120 (8% to 20%) students in second through fifth grade at a South Florida elementary school who exhibited behaviors that could lead to a diagnosis of ADHD, along with 18 to 42 (3% to 7%) students in second through fifth grade at a South Florida elementary school who could manifest behaviors severe enough to need services.

### ***Exclusion Criteria***

1. The estimated 480 to 552 (80% to 92%) students in second through fifth grade at a South Florida elementary school who would not exhibit behaviors that could lead to a diagnosis of ADHD, along with 558 to 582 (93% to 97%) students in second through fifth grade at a South Florida elementary school who would not manifest behaviors severe enough to need services were not eligible to participate in the research study.
2. Kindergarten and first grade students attending a South Florida elementary school were not eligible to participate in the research study.

### ***Accessible Population***

The accessible population consisted of 70 students attending a South Florida elementary school who had been previously identified as at-risk or clinically significant in the area of attention on the BASC. It has been estimated between 8% and 20% of school-age children exhibit behaviors that could lead to a diagnosis of ADHD, with 3% to 7% of those children manifesting behaviors severe enough to need services (Shaywitz & Shaywitz, 1997).

### ***Eligibility Criteria***

1. The 70 students in second through fifth grade at a South Florida elementary school who might have attention difficulties and who had been previously identified as at-risk or clinically significant in the area of attention on the BASC were eligible to participate in the research study.
2. The 60 students in second through fifth grade at a South Florida elementary school who had been identified as at-risk or clinically significant in the area of attention on the BASC, and for whom a parent signature was provided on the consent form and returned to the researcher prior to the beginning of the study, giving parental permission for were eligible to participate in the research study.
3. Students who verbally stated that they voluntarily wanted to participate in the research study were eligible.

### ***Exclusion Criteria***

1. The remaining 530 students in second through fifth grade at a South Florida elementary school, some of whom might have attention difficulties, but who

were not been previously identified as at-risk or clinically significant in the area of attention on the BASC were not eligible to participate in the research study.

2. The 10 students in second through fifth grade at a South Florida elementary school who had been previously identified as at-risk or clinically significant in the area of attention on the BASC, but for whom a parent signature was not provided on the consent form and returned to the researcher prior to the beginning of the study, giving parental permission were not eligible to participate in the research study.
3. Students who did not voluntarily want to participate in the research study would indicate verbally when asked by the researcher would not be eligible to participate in the research study.

***Sampling Plan: Total Accessible and Data Producing Sample***

The accessible population was identified as the group of 70 students with at-risk or clinically significant BASC classifications in the area of attention. Parental permission was obtained for 60 students out of the 70 students previously identified with at-risk or clinically significant BASC classifications in the area of attention. The 10 students without parental permission to participate in the study were excluded. The researcher assigned each of the 60 eligible students in the group a number. The numbers assigned to each student were written on individual pieces of paper and placed in an enclosed box. A colleague at the South Florida elementary school pulled one number out of the box and assigned that student to the experimental group. The second number pulled out of the box assigned that student to the control group. The process continued until there were 30

students assigned to the experimental group and 30 students assigned to the control group. The data producing sample in this research study resulted in an experimental group that consisted of 17 males and 13 females, and a control group that consisted of 25 males and five females. The number of males (42) verses females (18) in the study supports earlier documented research stating that boys are identified and diagnosed with ADHD more often than girls; four boys to every one girl (August et al., 1996; Carlson et al, 1997; Gershon, 2002; Greenblatt, 1994; Wolraich et al., 1998; Zentall, 2006).

### ***Evaluation of Sampling Design***

The accessible population consisted of 70 students identified as at-risk or clinically significant in the area of attention on the BASC. The data producing sample of 60 students that would participate in the research study were randomly assigned to either the experimental group or the control group. This method was used because of the small number of students in the population previously identified with at-risk or clinically significant BASC classifications in the area of attention at the South Florida elementary school. Due to the small population size, it was easy to assign each student a number that corresponded with the same number placed in an enclosed box. This method allowed each number to be easily selected out of an enclosed box in order for each student to be randomly assigned to either the experimental group or the control group. Random assignment resulted in an experimental group of 17 males and 13 females, while the control group resulted in 25 males and five females. Overall, there were 42 males that participated in the research study, and only 18 females. The number of males identified with attention concerns verses the number of females identified was consistent with the ratio of males verses females that are typically identified with attention concerns and

documented in the review of literature in Chapter II. The sample size used in this research study was based on the original number of students previously identified with at-risk or clinically significant BASC classifications in the area of attention at a South Florida elementary school. It also corresponded to the number of percussion instruments purchased by the researcher in order to conduct the study. The sample utilized was one of convenience due to the fact that the researcher is employed as a guidance counselor at the school site and frequently works with students identified with attention difficulties.

### *Student Characteristics*

The data producing sample consisted of 60 elementary school students, which consisted of 42 males (70.0%) and 18 females (30.0%). Random assignment resulted in an experimental group of 30 students, 17 males (56.7%) and 13 females (43.3%). The control group resulted in 30 students, 25 males (83.3%) and 5 females (16.7%).

The experimental group consisted of three students that were age 7 (10%), seven students that were age 8 (23.3%), eight students that were age 9 (26.7%), four students that were age 10 (13.3%), and eight students that were age 11 (26.7%). There were no students age 12 in the experimental group. The control group consisted of four students that were age 7 (13.3%), six students that were age 8 (20%), four students that were age 9 (13.3%), 10 students that were age 10 (33.3%), three students that were age 11 (10%), and three students that were age 12 (10%). Overall, the total data producing sample consisted of seven students age 7 (11.5%), 13 students age 8 (21.3%), 12 students age 9 (19.7%), 14 students age 10 (23%), 11 students age 11 (18%), and three students age 12 (4.9%). The estimated grade level ranged from second through fifth grade.

The experimental group consisted of three students from second grade (10%), seven students from third grade (23.3%), eight students from fourth grade (26.7%), and 12 students from fifth grade (40%). The control group consisted of four students from second grade (13.3%), six students from third grade (20%), four students from fourth grade (13.3%), and 16 students from fifth grade (53.3%). Overall, the data producing sample consisted of seven students from second grade (11.5%), 13 students from third grade (21.3%), 12 students from fourth grade (19.7%), and 28 students from fifth grade (45.9%).

The BASC classification of each student was labeled either at-risk or clinically significant in the area of attention. The experimental group consisted of 12 students (40%) labeled at-risk (4 girls, 8 boys) and 18 students (60%) labeled clinically significant (9 girls, 9 boys). The control group consisted of 10 students (33.3%) labeled at-risk (2 girls, 8 boys) and 20 students (66.7%) labeled clinically significant (3 girls, 17 boys). Overall, the data producing sample consisted of 22 students labeled at-risk (36.7%) and 38 students labeled clinically significant (63.3%).

### **Instrumentation**

#### ***Description of the Test of Variables of Attention (TOVA), Auditory and Visual***

This study used the TOVA, Auditory and Visual as a measure of auditory and visual attention skills in students participating in the research study. The TOVA, Auditory and Visual, are computerized tests that measure attention and impulse control. The TOVA, Auditory and Visual, can be used along with other diagnostic tools to assist in identifying attention concerns and diagnosing ADHD. The TOVA, Auditory and Visual, was developed by Dr. Lawrence Greenberg, Professor Emeritus and former Head



of Child and Adolescent Psychiatry at the University of Minnesota, to measure attention and impulse control in three areas: 1) inattention or omissions; 2) impulse control or commissions; and 3) response time in milliseconds (Greenberg, 2000). During the TOVA, Auditory, the stimuli are two audible tones; the target is “Middle G” and the non-target is “Middle C,” played through the computer. When the target sound of “Middle G” was heard, the student was instructed to press the micro-switch button. When the non-target sound of “Middle C” was heard, the student was instructed not to press the micro-switch button. During the TOVA, Visual, the stimuli are two geometric pictures that appear on the computer screen. A sample of the visual target and non-target appears in Figure 3-3 (Greenberg, 2000).



*Figure 3-3. Visual target and non-target for the TOVA, Visual.*

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*Note.* From Test of Variables of Attention: Professional Guide (p. 3), by L. M. Greenberg, 2000, Saint Paul, Minnesota: Universal Attention Disorders, Inc. Copyright 2000 by Lawrence Greenberg. Reprinted with permission.

The TOVA, Auditory and Visual are divided into four quarters over the entire test. The four quarters are also divided into two halves. Quarters 1 and 2 are considered

the first half of the TOVA, Auditory and Visual. The first half represents the stimulus infrequent condition, which has 36 targets out of 162 stimuli per quarter. Quarters 3 and 4 are considered the second half of the TOVA, Auditory and Visual. The second half represents the stimulus frequent condition, which has 126 targets out of 162 stimuli per quarter. The TOVA, Auditory and Visual, gives a score for each half of the test. The score for the first half represents the student's total score for quarters 1 and 2. The score for the second half represents the student's total score for quarter 3 and 4. The TOVA, Auditory and Visual, also calculates the student's total score for the entire test. The total test time of the TOVA, Auditory and Visual, is 21.6 minutes each. This total time breaks down into 10.8 minutes per half and 5.4 minutes for each quarter. Table 3-1 describes the breakdown of targets and non-targets for each quarter, half and total for the TOVA, Auditory and Visual (Greenberg, 2000).

Table 3-1

*TOVA Stimuli Breakdown*

	Quarter				Half		Total
	1	2	3	4	1	2	
# Targets	36	36	126	126	72	252	324
# Non-targets	126	126	36	36	252	72	324

*Note.* From Test of Variables of Attention: Professional Guide (p. 3), by L. M. Greenberg, 2000, Saint Paul, Minnesota: Universal Attention Disorders, Inc. Copyright 2000 by Lawrence Greenberg. Reprinted with permission.

The TOVA, Auditory and Visual, records each time the student responds to either a target or non-target by pressing the micro-switch throughout the entire test. It also records when the student does not respond to a target. The time it takes for a student to respond is also calculated. The following is a list of the assessments that the TOVA, Auditory and Visual, measures throughout the entire test (Greenberg, 2000).

1. Omissions: Errors of omission are recorded when the student does not respond to the target. Errors of omission are reported as a percentage and are considered to be a measure of inattention.
2. Commissions: Errors of commission are recorded when the student responds to a non-target. Errors of commission are reported as a percentage and are considered to be a measure of impulsivity.
3. Response Time: The time it takes the student to respond correctly to a target. Response time is reported in milliseconds for each quarter, half and total.
4. Response Time Variability: The inconsistency in the time it takes the student to respond to each target. The response time variability score is reported as the standard deviation of the mean correct response times.
5. d' (d prime) Score: The rate of a student's deterioration in performance over the entire test.
6. ADHD Score: The student's performance on the TOVA, Auditory and Visual, compared to an ADHD sample's performance.
7. Post-Commission Response Time: The measure of time (in milliseconds) that the student took to respond to a target immediately following a response to a non-target.

8. Anticipatory Response: When a student presses the micro-switch within 200 milliseconds of the appearance of a stimulus; either a target or a non-target. This score represents the student's guess to the next pending stimulus.
9. Multiple Responses: When a student presses the micro-switch more than once per stimulus presentation to either a target or a non-target.

### ***Reliability for the TOVA, Auditory***

The TOVA, Auditory, is also a timed test, which makes using Cronbach's alpha to measure reliability inappropriate (Anastasi, 1988). Pearson product coefficients ( $r$ ) were computed for the variables omission, commission, response time, response time variability, and  $d$  prime for both the stimulus infrequent and stimulus frequent conditions. To test the reliability of the TOVA, Auditory, a normative sample ( $n = 2551$ ) was randomly selected from elementary and high schools in three metropolitan, Minneapolis, Minnesota, suburban public schools (Greenberg & Waldman, 1993). The students were primarily Caucasian (99% Caucasian, 1% other) ranging in age from 6 to 19 years. Inclusion criteria included deviant classroom behavior, current use of psychoactive medication, or receiving special education services.

Table 3-3 gives reliability data on the variables within the stimulus infrequent and stimulus frequent conditions of the TOVA, Auditory. The reliability coefficients for the stimulus infrequent condition (quarters 1 and 2) and the stimulus frequent condition (quarters 3 and 4) support that the variables are consistent within each variable over both conditions, yet distinct between each variable (Greenberg, 2000).

Table 3-2

*Within Condition 1 and Condition 2 Reliability Coefficients, Auditory*

Variable	Condition 1	Condition 2
	Quarter 1 to Quarter 2	Quarter 3 to Quarter 4
Omission	.8082	.9358
Commission	.8664	.8299
Response Time (msec)	.9149	.8790
RT Variability	.7488	.8654
D Prime	.6347	.7388

*Note.* From Test of Variables of Attention: Professional Guide (p. 25), by L. M. Greenberg, 2000, Saint Paul, Minnesota: Universal Attention Disorders, Inc. Copyright 2000 by Lawrence Greenberg. Reprinted with permission.

The reliability coefficients for the percentage of omission errors within condition 1 are: 1) between quarters 1 and 2,  $r = .8082$ ; 2) quarters 1 and 2 to first half,  $r = .9416$  and  $.9593$ ; 3) quarters 1 and 2 to total omission errors,  $r = .7325$  and  $.7896$ ; and 4) first half to total omission errors,  $r = .9873$ . This value indicates that the test measures the percentage of omission errors between the two quarters over the first condition consistently (Greenberg, 2000).

The reliability coefficients for the percentage of commission errors within condition 1 are: 1) between quarters 1 and 2,  $r = .8664$ ; 2) quarters 1 and 2 to first half,  $r = .9635$  and  $.9683$ ; 3) quarters 1 and 2 to total commission errors,  $r = .8599$  and  $.8841$ ; and 4) first half to total commission errors,  $r = .9033$  (Greenberg, 2000).

The reliability coefficients for response time (mean response time) within condition 1 are: 1) between quarters 1 and 2,  $r = .9149$ ; 2) quarters 1 and 2 to first half,  $r = .9751$  and  $.9808$ ; 3) quarters 1 and 2 to total response time,  $r = .8500$  and  $.8788$ ; and 4) first half to total response time,  $r = .8845$  (Greenberg, 2000).

The reliability coefficients for response time (RT) within condition 1 are: 1) between quarters 1 and 2,  $r = .7488$ ; 2) quarters 1 and 2 to first half,  $r = .9125$  and  $.9462$ ; 3) quarters 1 and 2 to total response time,  $r = .8004$  and  $.8275$ ; and 4) first half to total response time,  $r = .8702$  (Greenberg, 2000).

The reliability coefficients for d prime within condition 1 are: 1) between quarters 1 and 2,  $r = .6347$ ; 2) quarters 1 and 2 to first half,  $r = .8427$  and  $.8718$ ; 3) quarters 1 and 2 to total d prime,  $r = .6680$  and  $.6801$ ; and 4) first half to total d prime,  $r = .7525$  (Greenberg, 2000).

Condition 2 (stimulus frequent) data followed condition 1 (stimulus infrequent). The reliability coefficients for the percentage of omission errors within condition 2 are: 1) between quarters 3 and 4,  $r = .9538$ ; 2) quarters 3 and 4 to second half,  $r = .9834$  and  $.9842$ ; 3) quarters 3 and 4 to total omission errors,  $r = .9806$  and  $.9769$ ; and 4) second half to total omission errors,  $r = .9949$  (Greenberg, 2000).

The reliability coefficients for the percentage of commission errors within condition 2 are: 1) between quarters 3 and 4,  $r = .8299$ ; 2) quarters 3 and 4 to second half,  $r = .9476$  and  $.9645$ ; 3) quarters 3 and 4 to total commission errors,  $r = .7778$  and  $.7051$ ; and 4) second half to total commission errors,  $r = .7701$  (Greenberg, 2000).

The reliability coefficients for response time within condition 2 are: 1) between quarters 3 and 4,  $r = .8790$ ; 2) quarters 3 and 4 to second half,  $r = .9750$  and  $.9509$ ; 3) quarters 3 and 4 to total response time,  $r = .9668$  and  $.9372$ ; and 4) second half to total response time,  $r = .9857$  (Greenberg, 2000).

The reliability coefficients for response time variability within condition 2 are: 1) between quarters 3 and 4,  $r = .8654$ ; 2) quarters 3 and 4 to second half,  $r = .9632$  and

.9546; 3) quarters 3 and 4 to total response time variability,  $r = .9535$  and  $.9436$ ; and 4) second half to total response time variability,  $r = .9875$  (Greenberg, 2000).

The reliability coefficient for d prime within condition 2 are: 1) between quarters 3 and 4,  $r = .7388$ ; 2) quarters 3 and 4 to second half,  $r = .8869$  and  $.9223$ ; 3) quarters 3 and 4 to total d prime,  $r = .8664$  and  $.8929$ ; and 4) second half to total d prime,  $r = .9655$  (Greenberg, 2000).

### ***Reliability for the TOVA, Visual***

Reliability suggests the same data would result following repeated measures using the same technique (Babbie, 2001). To calculate reliability coefficients for the TOVA, Visual, Pearson product coefficients ( $r$ ) were computed for the variables omission, commission, response time, response time variability, and d prime across both the stimulus infrequent and stimulus frequent conditions. The TOVA, Visual, is a timed test. Therefore, Pearson product coefficients ( $r$ ) were used as a measure of the tests reliability, because traditional reliability coefficients, like Chronbach's alpha are not appropriate for timed tests (Anastasi, 1988). To test the reliability of the TOVA, Visual, a normative sample ( $n = 769$ ) was randomly selected and consisted of first, third, fifth, seventh, and ninth grade students from public schools in suburban Minneapolis, Minnesota (Greenberg & Waldman, 1993). The students were primarily Caucasian (99% Caucasian, 1% other) ranging in age from 6 to 16 years. Inclusion criteria included students that exhibited deviant classroom behavior, were currently using psychoactive medication or receiving special education services. An additional normative sample ( $n = 571$ ) were randomly selected from an earlier study, which consisted of students from an earlier education screening project. This project was comprised of primarily Caucasian students (99%

Caucasian, 1% other) from one suburban public grade school and one rural public high school around Minneapolis, Minnesota (Greenberg, 2000).

Table 3-2 gives reliability coefficients for the variables within condition 1 (stimulus infrequent), and condition 2 (stimulus frequent) of the TOVA, Visual. The reliability coefficients for the stimulus infrequent condition (quarters 1 and 2) and the stimulus frequent condition (quarters 3 and 4) support that the variables are consistent within each variable over both conditions, yet distinct between each variable (Greenberg, 2000).

Table 3-3

*Within Condition 1 and Condition 2 Reliability Coefficients, Visual*

Variable	Condition 1	Condition 2
	Quarter 1 : Quarter 2	Quarter 3 : Quarter 4
Omission	.7243	.7010
Commission	.7854	.8200
Response Time (msec)	.9282	.9278
RT Variability	.6970	.8604
D Prime	.5166	.7205

*Note.* From Test of Variables of Attention: Professional Guide (p. 20), by L. M. Greenberg, 2000, Saint Paul, Minnesota: Universal Attention Disorders, Inc. Copyright 2000 by Lawrence Greenberg. Reprinted with permission.

The reliability coefficients for the percentage of omission errors within the condition 1 are as follows: 1) between quarters 1 and 2,  $r = .7243$ ; 2) quarters 1 and 2 to first half,  $r = .9225$  and  $.9329$ ; 3) quarters 1 and 2 to total omission errors,  $r = .7915$  and  $.8471$ ; and 4) first half to total omission errors,  $r = .8829$  (Greenberg, 2000).

The reliability coefficients for the percentage of commission errors within the condition 1 are as follows: 1) between quarters 1 and 2,  $r = .7854$ ; 2) quarters 1 and 2 to



first half,  $r = .9512$  and  $.9305$ ; 3) quarters 1 and 2 to total commission errors,  $r = .7962$  and  $.7097$ ; and 4) first half to total commission errors,  $r = .7970$  (Greenberg, 2000).

The reliability coefficients for the response time reliability within condition 1 are: 1) between quarters 1 and 2,  $r = .9282$ ; 2) quarters 1 and 2 to first half,  $r = .9789$  and  $.9838$ ; 3) quarters 1 and 2 to total response time reliability,  $r = .8960$  and  $.9134$ ; and 4) first half to total response time reliability,  $r = .8927$  (Greenberg, 2000).

The reliability coefficients for response time variability within condition 1 are: 1) between quarters 1 and 2,  $r = .6970$ ; 2) quarters 1 and 2 to first half,  $r = .8927$  and  $.9382$ ; 3) quarters 1 and 2 to total response time variability reliability,  $r = .8030$  and  $.8404$ ; and 4) first half to total response time variability reliability,  $r = .9217$  (Greenberg, 2000).

The reliability coefficients for the d prime values within condition 1 are: 1) between quarters 1 and 2,  $r = .5166$ ; 2) quarters 1 and 2 to first half,  $r = .8094$  and  $.8204$ ; 3) quarters 1 and 2 to total d prime,  $r = .5565$  and  $.5489$ ; and 4) first half to total d prime,  $r = .7205$  (Greenberg, 2000).

Between variable coefficients supported the variables are different from one another. Percentage of omission to percentage of commission coefficients, while statistically significant ( $p < .001$ ), were not generally robust. The relationship between percentages of omission errors to the other variables did not show a strong relationship (Greenberg, 2000).

Percentage of commission errors to response time correlations failed to result in statistical significance for all variable relationships. When statistical significance was found, the relationships were not strong relationships, with ranges from  $.0523$  to  $.1184$ .

Commission to response time variability relationships, while statistically significant ( $p < .001$ ), supports a limited relationship between the two variables (Greenberg, 2000).

Response time and response time variability relationships were statistically significant ( $p < .001$ ) and the data supported the relationship between the two variables. The within quarter relationships were stronger than the between quarter relationships between the two variables (Greenberg, 2000).

Condition 2 data followed the same format as condition 1 data. The reliability coefficients for the percentage of omission errors within condition 2 were as follows: 1) between quarters 3 and 4,  $r = .7010$ ; 2) quarter 3 and 4 to second half,  $r = .9203$  and  $.9329$ ; 3) quarter 3 and 4 to total omission errors,  $r = .7915$  and  $.8471$ ; and 4) second half to total omission errors,  $r = .8829$  (Greenberg, 2000).

The reliability coefficients for the percentage of commission errors within condition 2 were as follows: 1) between quarters 3 and 4,  $r = .8200$ ; 2) quarters 3 and 4 to second half,  $r = .9447$  and  $.9616$ ; 3) quarters 3 and 4 to total commission errors,  $r = .8965$  and  $.8879$ ; and 4) second half to total commission errors,  $r = .9343$  (Greenberg, 2000).

The reliability coefficients for response time within condition 2 are: 1) between quarters 3 and 4,  $r = .9278$ ; 2) quarters 3 and 4 to second half,  $r = .9802$  and  $.9824$ ; 3) quarter 3 and 4 to total response time reliability,  $r = .9791$  and  $.9707$ ; and 4) second half to total response time reliability,  $r = .9929$  (Greenberg, 2000).

The reliability coefficients for response time variability within condition 2 are: 1) between quarters 3 and 4,  $r = .8654$ ; 2) quarter 3 and 4 to second half,  $r = .9543$  and  $.9722$ ; 3) quarter 3 and 4 to total response time variability reliability,  $r = .9456$  and  $.9588$ ;

and 4) second half to total response time variability reliability,  $r = .9873$  (Greenberg, 2000).

The reliability coefficients for d prime within condition 2 are: 1) between quarters 3 and 4,  $r = .8654$ ; 2) quarter 3 and 4 to second half,  $r = .9543$  and  $.9722$ ; 3) quarter 3 and 4 to total d prime,  $r = .9456$  and  $.9588$ ; and 4) second half to total d prime,  $r = .9873$  (Greenberg, 2000).

### *Validity for the TOVA, Auditory and Visual*

Validity refers to a test's ability to adequately measure what it is reported to measure and how well it does in measuring it (Babbie, 2001). The TOVA was designed to measure variables that have been found to be important in differentiating ADHD subjects from subjects without ADHD. The ability of TOVA to correctly identify ADHD is called sensitivity. The ability of the TOVA to correctly identify non-ADHD is called specificity (Greenberg, 2000).

To study the validity of the TOVA, Greenberg and Crosby (1992) examined 73 subjects diagnosed with ADHD. The sample consisted of 62 males and 11 females. The researchers screened each subject for co-existing psychiatric problems and included only subjects with a diagnosis of ADHD. The subjects were all referred to the Clinic for Attention Deficit Disorders at the University of Minnesota. The TOVA was administered to each subject; calculating five measures: errors of omission, errors of commission, response time, response time variability, and d prime. TOVA scores for each of the five measures were converted to z-scores based upon normative data for age and gender. The researchers used a one-way MANOVA to compare z-scores for the ADHD sample to a normative sample. Discriminant analysis and equal weighting of summed standardized

scores were used in classification. A random sample of half of the ADHD sample and half of the normative sample were selected. Two distinct cutoff points were identified to achieve false positive rates. The cutoff points of .90 and .80 specificity were set (Greenberg, 2000).

### ***Discriminant Analysis***

The first model of classification, initial discriminant analysis, was performed on the five measures of the TOVA. Researchers found a correlation ( $r = .553$ ) between anticipatory errors or d prime and commission errors. Therefore, a second analysis of only four variables (errors of omission, errors of commission, response time, and response time variability) was conducted. This analysis revealed the four variables were significantly able to predict group membership (canonical correlation = .562; Wilks' lambda = .684;  $p < .001$ ). All four variables were significantly correlated to the discriminant function with values ranging from .423 (errors of commission) to .979 (response time variability). The .80 specificity cutoff point was .337, with a sensitivity of .694. The .90 specificity cutoff point was .793, with a sensitivity of .667. The cutoff points of .337 and .793, from the first analysis, were then applied to the remaining ADHD sample and the remaining normative sample. The cutoff point of .337, when applied to the remaining sample, resulted in a sensitivity of .730 and a specificity of .727. The cutoff point of .793, when applied to the remaining ADHD sample and the remaining normative sample, resulted in a sensitivity of .676 and specificity of .847 (Greenberg, 2000).

### *Equal Weighting of Summed Standardized Scores*

The second model of classification used by the researchers was equal weighting of summed standardized scores. These scores were computed for the first sample of 36 ADHD subjects and 384 non-ADHD subjects. Equal weighting of summed standard scores or z scores for each of the four variables (errors of omission, errors of commission, response time, and response time variability) were computed. The .80 specificity cutoff point of 1.94 resulted in a sensitivity rate of .757. The .90 specificity cutoff point of 3.42 resulted in a sensitivity rate of .595. Equal weighting of summed standardized scores were computed for the second sample using the cutoff points established in the first analysis. The cutoff points of 1.94 and 3.42, from the first analysis, were then applied to the remaining sample. The cutoff point of 1.94, when applied to the remaining sample, resulted in a sensitivity of .722 and a specificity of .849. The cutoff point of 3.42, when applied to the remaining sample, resulted in a sensitivity of .611 and a specificity of .943 (Greenberg, 2000).

As summarized in Table 3-4, Greenberg and Crosby (1992) found both discriminant analysis and equal weighting of summed standardized scores produced similar levels of sensitivity and specificity for the TOVA. The ability of the TOVA to adequately identify ADHD students and adequately identify non-ADHD students is strong at .80 and .90 specificity for discriminant analysis and equal weighting of summed standardized scores (Greenberg, 2000).

Table 3-4

*Comparison of Classification Methods*

Method	1 <sup>st</sup> Sample		2 <sup>nd</sup> Sample	
	Sensitivity	Specificity	Sensitivity	Specificity
Discriminant Analysis	.694	.800	.730	.727
	.667	.900	.676	.847
Equal Weighting	.757	.800	.722	.849
	.595	.900	.611	.943

*Note.* From Test of Variables of Attention: Professional Guide (p. 33), by L. M. Greenberg, 2000, Saint Paul, Minnesota: Universal Attention Disorders, Inc. Copyright 2000 by Lawrence Greenberg. Reprinted with permission.

***Factor Analysis***

For the TOVA, Visual, the percentage of commission errors, percentage of omission errors, mean response time, response time variability, and d prime across both conditions by quarter, half, and total were entered into a principle components varimax rotation factor analysis (n = 1468). The following four factors emerged as a result: 1) response time (mean response time, response time variability); 2) d prime (hit to miss ratio); 3) percentage of commission errors; and 4) percentage of omission errors (Greenberg, 2000).

For the TOVA, Auditory, the percentage of commission and omission errors, mean response time, response time variability, and d prime across both conditions were entered into a principle components varimax rotation factor analysis (n = 2551). The following six factors emerged as a result: 1) response time (mean response time and response time variability); 2) percentage of commission errors (stimulus frequent

condition); 3) d prime; 4) percentage of omission errors (stimulus frequent condition); 5) percentage of commission errors (stimulus infrequent condition); and 6) percentage of omission errors (stimulus infrequent condition) (Greenberg, 2000).

### ***Comparison of the TOVA, Auditory and TOVA, Visual***

In order to compare total variable scores between the TOVA, Auditory and Visual, an analysis of covariance (ANCOVA), controlling for age and gender, was performed. As indicated in Table 3-5, the analysis found a higher mean percentage of omission errors with the TOVA, Auditory than the TOVA, Visual (Greenberg, 2000).

The TOVA, Auditory ( $M = 3.99$ ,  $SD = 10.92$ ) had twice as high omission errors than the TOVA, Visual ( $M = 2.06$ ,  $SD = 5.49$ ). The mean percentages of commission errors were higher for the TOVA, Visual ( $M = 5.73$ ,  $SD = 5.11$ ) than the TOVA, Auditory ( $M = 2.41$ ,  $SD = 5.23$ ). The mean response times were faster for the TOVA, Visual ( $M = 445.00$ ,  $SD = 117.93$ ) than the TOVA, Auditory ( $M = 586.28$ ,  $SD = 139.31$ ). The response time variability was greater for the TOVA, Auditory ( $M = 183.46$ ,  $SD = 79.85$ ) than the TOVA, Visual ( $M = 137.61$ ,  $SD = 62.78$ ). The analysis found all mean scores between each test differences to be significant ( $p < .001$ ) (Greenberg, 2000).

### **Procedures: Ethical Considerations and Data Collection Methods**

1. Obtain permission to use the TOVA, Auditory and Visual (see Appendix A).
2. The school district informed the researcher that district permission was not needed because the data-gathering activities were within the researcher's job function as a guidance counselor (see Appendix B).

3. Approval to conduct the study was granted from Lynn University's Institutional Review Board for the Protection of Human Subjects (IRB). IRB approval was obtained on February 16, 2005 (see Appendix C).
4. Following IRB approval, parental permission was obtained for each student prior to participation in the research study. The parents of the subjects were informed in writing of the exact nature of the research study through correspondence sent home with each student. A consent form was included for parents to sign and return to the researcher, giving permission for each student to participate in the research study. The consent form informed parents that the project was being conducted in fulfillment of the dissertation requirements at Lynn University, that student participation is voluntary and that all personal student information will be kept in confidence and not included in the document. Each consent form needed to be returned to the researcher prior to the beginning of the study. The school district informed the researcher in writing that district permission was not needed because the data-gathering activities were within the researcher's job function (see Appendix D).
5. After parental permission was obtained for each student, data collection began April 4, 2005 by the researcher using the BASC as criterion to participate in the study, and the TOVA to determine the auditory and visual attention skills level at the pre-test and post-test assessment times. The BASC is the first scale to adequately separate each of the characteristics necessary to differentiate between ADHD and Behavior Disorder, Conduct Disorder, ADD without Hyperactivity, or Overanxious Disorders. The BASC is used to identify several behavior disorders



in children. The BASC is based on the teacher's and parent's rating of the child's behavior, both at school and at home. Any score that falls in the clinically significant range suggests the student is having great difficulty in a specific area. BASC scores that fall in the at-risk range suggest a concern in a specific area. At-risk scores in an area may have the potential to develop into something more serious and should be carefully monitored. The BASC includes scales for assessing hyperactivity, inattention, conduct problems, internalizing problems, and adaptive behaviors.

6. The TOVA, Auditory was administered to each subject by the researcher beginning April 4, 2005. During the TOVA, Auditory, the stimuli are two easily discriminated audible tones, the target is "Middle G" and the non-target is "Middle C," played on the computer. Like the visual test, the auditory test has two conditions, stimulus infrequent and stimulus frequent. The subjects were instructed to press the micro-switch as quickly as possible after they heard the target stimulus. They were instructed to not press the switch (i.e., do nothing) when they hear the non-target. The targets and non-targets are pre-designed to sound at two different conditions, stimulus infrequent and stimulus frequent. Quarters 1 and 2 are considered stimulus infrequent conditions and are comprised of 36 targets and 126 non-targets per quarter. Quarters 3 and 4 are considered stimulus frequent conditions and are comprised of 126 targets and 36 non-targets per quarter. The test is internally timed to last for 21.6 minutes (Greenberg, 2000).

- a. The TOVA, Auditory utilizes a 3-minute practice test to assure that the subject understands the testing conditions and instructions. The computer and monitor were turned on with the appropriate test program booted up prior to the subject entering the test room. The test examiner entered the necessary demographic information needed to run the test.
  - b. Detailed instructions were then read to each subject prior to the administration of the TOVA, Auditory (see Appendix F).
7. The TOVA, Visual was then administered to each subject by the researcher beginning April 11, 2005. The subjects were presented with visually presented targets and non-targets. The subjects were instructed to press the micro-switch as quickly as possible after they see the target stimulus. They were instructed to not press the switch (i.e., do nothing) when they see the non-target. The targets and non-targets are pre-designed to appear at two different conditions, stimulus infrequent and stimulus frequent. Quarters 1 and 2 are considered stimulus infrequent conditions and are comprised of 36 targets and 126 non-targets per quarter. Quarters 3 and 4 are considered stimulus frequent conditions and are comprised of 126 targets and 36 non-targets per quarter. The test is internally timed to last for 21.6 minutes (Greenberg, 2000).
- a. The TOVA, Visual, utilizes a 3-minute practice test to assure that the subject understands the testing conditions and instructions. The computer and monitor were turned on with the appropriate test program booted up prior to the subject entering the test room. The

test examiner entered the necessary demographic information needed to run the test.

- b. Detailed instructions were then read to each subject prior to the administration of the TOVA, Visual (see Appendix E).

8. Following the pre-test administration of the TOVA, Auditory and TOVA, Visual, the experimental group began the World Music Drumming program on April 18, 2005 as treatment for 30 minutes, twice a week, for seven weeks (fourteen sessions) concluding April 29, 2005. The control group did not receive the World Music Drumming program as treatment. The fourteen sessions were chosen in order to adequately cover Unit 1, *Beginning to Ensemble 1*, of the World Music Drumming curriculum.

- a. World Music Drumming utilizes the motivation of hands-on drumming to teach cultural appreciation through drumming, respect for different cultures, and how to communicate and work together (Schmid, 1998). The active hands-on approach of World Music Drumming allows movement for those students who need it most. The World Music Drumming curriculum has seven units. The curriculum is taught orally by the drum leader and follows a communication model of call and response. Call and response is a strategy where the drum leader plays a beat and the students echo back the same beat.

- b. The World Music Drumming curriculum objectives are to teach respect, personal space, communication skills, and focus through drumming (Schmidt, 1998).
  - c. World Music Drumming may be applied to a variety of settings and populations. The World Music Drumming intervention received by the experimental group was lead by the music teacher with the researcher observing to avoid researcher bias. The experimental group met in the music room. A drum circle was developed with each student sitting in a moveable chair. This allowed everyone in the drum circle to easily see the leader and each other. It was also much more in tune with the cultures being studied.
  - d. The following drums and percussion instruments were used in the research study: 10" tunable tubanos (high pitched congas), 12" tunable tubanos (medium pitched congas), 14" tunable tubanos (low pitched congas), 12" tunable djembe (solo/teacher use), talking drum (small) with stick, 16" frame drums, rattles, medium gankogui (double bell from Ghana), large gankogui (double bell from Ghana), shekere with seeds/netting (from Ghana), small cowbells, maracas (pairs), claves (pairs), and guiros with a stick.
9. Following the experimental group's seven-week World Music Drumming program intervention, both the experimental group and the control group were given the TOVA, Auditory and TOVA, Visual, as a post-test measure, beginning

May 2, 2005 and concluding May 18, 2005. The administration of the TOVA, Auditory and Visual followed the same procedures as in steps 6 and 7.

10. The Lynn University IRB Report of Termination of Project was submitted at the end of the research study in June 2005.
11. The next step was for the researcher to compile the TOVA pre-test and post-test data and input the data into SPSS for analysis.
12. SPSS for Windows versions 11.0 and 14.0 were used in the data analyses as explained in the analysis of data portion of this chapter.
13. All TOVA, Auditory and Visual, documentation will be kept in a secured location for five years.
14. All documentation from this study will be destroyed after five years.

### **Methods of Data Analysis**

Descriptive statistics were used to answer the first two research questions by describing the characteristics of the sample while multiple regression was used to test for a relationship between student attribute variables and TOVA scores. Independent (between groups) samples *t*-tests and paired (within groups) samples *t*-tests were used to test the nine research hypotheses. Data were analyzed using SPSS for Windows versions 11.0 and 14.0.

### **Evaluation of Research Methods**

The greatest advantage of an experimental design is the accuracy in which it shows the impact that the experimental variable has on the dependent variable over a period of time (Babbie, 2001). In a classical experiment, subjects are identified to have certain characteristics. The subjects are assigned to either an experimental group or a

control group. The experimental group receives the experimental stimulus and the control group does not receive the experimental stimulus. Following the administration of an experimental stimulus, the subjects in the experimental group are found to have a different characteristic (Babbie, 2001). It can be concluded that the change in characteristics is attributable to the experimental stimulus, provided the subjects have not experienced any other stimuli that would affect the outcome. The knowledge that an experiment is being conducted and what the experiment is measuring is enough to influence the outcome of a study, which is called the Hawthorne effect (Ary, Jacobs, & Razavieh, 1990; Babbie, 2001). Subjects can be influenced by what is known about the study by focusing their attention on what is being measured. Researchers may observe improvements in subjects in the experimental group over the control group based on knowledge of who was assigned to each group. Researchers can control for the Hawthorne effect by using a double-blind experiment, which eliminates the researcher's knowledge of who is in the experimental and control groups, as well as the subject's knowledge of what is being measured (Babbie, 2001). To further strengthen the validity of the experiment, a replication study can be conducted utilizing new subjects. A replication study with the same research findings adds validity and generalizability of those findings (Babbie, 2001). The research methods used were evaluated in order to determine the validity of this study.

### ***Internal Validity***

Internal validity in a research study refers to when the outcome of an experiment accurately explains what has occurred in the study (Babbie, 2001). Internal validity addresses whether the experimental treatment brought about change in the dependent

variable. Internal validity is threatened when some outside variable affects the dependent variable, therefore affecting the outcome of the study (Babbie, 2001).

### ***Key Strengths***

A true experimental design with the random assignment of subjects strengthens the internal validity of a study (Campbell & Stanley, 1963; Cook & Campbell, 1979). Therefore, the use of a classic or true experimental design in this study, with the random assignment of subjects, strengthened internal validity. In order to strengthen the internal validity of a study, an instrument with good estimates of reliability and established validity should be used. The TOVA, Auditory and Visual, had good estimates of reliability and established validity, providing strength to the study.

### ***Key Threats***

There are several threats to internal validity that can affect a research study (Campbell & Stanley, 1963; Cook & Campbell, 1979). Throughout a research study, situations can happen that affect the outcome. The students that participated in the study could have other variables, such as beginning medication treatment to address attention concerns, affect their participation in the study. This weakened the internal validity of this study. Also, the fact that the experimental group and the control group were not similar in student characteristics weakened the internal validity of the study. Throughout the research study, the subjects involved interacted with each other throughout the school day. There is a possibility that this interaction with each other regarding some elements of the experimental stimulus may have contaminated the control group. This idea is called diffusion or imitation of treatment, and was a threat to the internal validity of this study.

### ***External Validity***

External validity in a research study refers to when the outcome of an experiment can be generalized to a larger population (Babbie, 2001). External validity addresses what population, settings, experimental variables, and measurement variables can the findings be generalized (Ary et al., 1990). External validity is threatened when a small sample size is used (Babbie, 2001).

#### ***Key Strengths***

One way to strengthen external validity is to obtain a sample that is representative of the population. Overall, there were 42 males and 18 females that participated in the research study. Research suggests that boys are identified and diagnosed with ADHD more often than girls; an average of four boys to every one girl (August et al., 1996; Carlson et al., 1997; Gershon, 2002; Greenblatt, 1994; Wolraich et al., 1998; Zentall, 2006). This number is representative of the number of males verses females that are typically identified with attention difficulties. This adds strength to the external validity of the study, despite the fact that this study was weak in external validity. A larger sample size would strengthen the external validity of the study.

#### ***Key Threats***

A concern in the area of external validity was the use of the classical experimental design and that the experimental results obtained may not reflect real life, even if the results of the experiment were an accurate gauge of what happened during that experiment. Therefore, the sample of convenience threatened the external validity of the study. Also the small sample size used threatened the external validity of the study. Due to the nature of a classic experimental design, the pre-test may have affected the outcome



of the post-test. Because the students understood that the pre-test was measuring their auditory and visual attention skills, this could have affected their participation in the treatment and also their post-test performance. Because a classic experimental design was used, the interaction of the testing situation and experimental stimulus was a threat to the external validity of this study.

Chapter III presented the methodology used in answering the research questions and testing the hypotheses of this study about the relationship between World Music Drumming and auditory and visual attention skills. Chapter IV presents the results of the data analyses performed in order to answer the research questions and test the hypotheses of this study.

## **CHAPTER IV**

### **RESULTS**

Chapter IV presents the examination of research questions, hypotheses testing and other findings related to this study about the effect of World Music Drumming on the auditory and visual attention skills of students identified with attention difficulties at a South Florida elementary school. Descriptive statistics, including measures of central tendency and frequency distributions, were used to answer research questions one and two by describing the characteristics of the sample and the relationship among the variables in the sample. Multiple regression analyses were used to answer research question three and to test the relationships between the independent variables and the dependent variable. Independent (between groups) samples *t*-tests and paired (within groups) samples *t*-tests were used to test the nine research hypotheses.

#### **Research Questions**

Descriptive statistics were used to describe the characteristics of the sample and the relationship among the variables in the sample. The independent variables of gender, age, estimated grade level, and BASC classification of each student was examined, with frequencies and measures of central tendency being reported. Multiple regression analyses were used to measure the strength of the relationship between sample characteristics and the dependent and independent variables ( $p \leq .05$ ). Multiple regression analyses tested the relationship between sample characteristics and TOVA auditory and visual error scores, in terms of the relative contribution of each sample characteristics.

### ***Research Question 1: Descriptive Characteristics of the Sample***

*What are the gender, age, estimated grade level, and BASC classifications of the second through fifth grade students with attention difficulties who participated in this study?*

As indicated in Table 4-1, the data producing sample was made up of 60 students. The students ranged from age 7 to age 12. The total sample consisted of 42 males (70.0%) and 18 females (30.0%). Random assignment resulted in an experimental group of 30 students, 17 males (56.7%) and 13 females (43.3%). The control group resulted in 30 students, 25 males (83.3%) and 5 females (16.7%).

The experimental group consisted of three students that were age 7 (10%), seven students that were age 8 (23.3%), eight students that were age 9 (26.7%), four students that were age 10 (13.3%), and eight students that were age 11 (26.7%). There were no students age 12 in the experimental group. The control group consisted of four students that were age 7 (13.3%), six students that were age 8 (20%), four students that were age 9 (13.3%), 10 students that were age 10 (33.3%), three students that were age 11 (10%), and three students that were age 12 (10%). Overall, the total sample consisted of seven students age 7 (11.5%), 13 students age 8 (21.3%), 12 students age 9 (19.7%), 14 students age 10 (23%), 11 students age 11 (18%), and three students age 12 (4.9%).

Table 4-1

*Descriptive Characteristics of the Sample (N=60)*

Descriptive Characteristic	Experimental Group		Control Group		Total Sample	
	Frequency	Valid Percent	Frequency	Valid Percent	Frequency	Valid Percent
Gender						
Male	17	56.7%	25	83.3%	42	70.0%
Female	13	43.3%	5	16.7%	18	30.0%
Age						
7	3	10.0%	4	13.3%	7	11.5%
8	7	23.3%	6	20.0%	13	21.3%
9	8	26.7%	4	13.3%	12	19.7%
10	4	13.3%	10	33.3%	14	23.0%
11	8	26.7%	3	10.0%	11	18.0%
12	0	0.0%	3	10.0%	3	4.9%
Grade Level						
Second	3	10.0%	4	13.3%	7	11.5%
Third	7	23.3%	6	20.0%	13	21.3%
Fourth	8	26.7%	4	13.3%	12	19.7%
Fifth	12	40.0%	16	53.3%	28	45.9%
BASC Classification						
At-risk	12	40.0%	10	33.3%	22	36.7%
Clinically Sig.	18	60.0%	20	66.7%	38	63.3%
Girls At-risk	4	13.3%	2	6.7%	6	10.0%
Clinically Sig.	9	30.0%	3	10.0%	12	20.0%
Boys At-risk	8	26.7%	8	26.7%	16	26.7%
Clinically Sig.	9	30.0%	17	56.7%	26	43.3%

The estimated grade level ranged from second through fifth grade. The experimental group consisted of three students from second grade (10%), seven students from third grade (23.3%), eight students from fourth grade (26.7%), and 12 students from fifth grade (40%). The control group consisted of four students from second grade (13.3%), six students from third grade (20%), four students from fourth grade (13.3%), and 16 students from fifth grade (53.3%). Overall, the sample consisted of seven students from second grade (11.5%), 13 students from third grade (21.3%), 12 students from fourth grade (19.7%), and 28 students from fifth grade (45.9%).

The BASC classification of each student was labeled either at-risk or clinically significant in the area of attention. The experimental group consisted of 12 students (40%) labeled at-risk (4 girls, 8 boys) and 18 students (60%) labeled clinically significant (9 girls, 9 boys). The control group consisted of 10 students (33.3%) labeled at-risk (2 girls, 8 boys) and 20 students (66.7%) labeled clinically significant (3 girls, 17 boys). Overall, the sample consisted of 22 students labeled at-risk (36.7%) and 38 students labeled clinically significant (63.3%).

### ***Research Question 2: TOVA Error Scores of the Sample***

*What are the pre-test and post-test TOVA auditory and visual percentage of error scores, and response time scores of the second through fifth grade students with attention difficulties who participated in this study?*

As indicated in Table 4-2, the total sample TOVA auditory errors of commission (impulsivity) decreased for the total sample (-1.04), while the errors of omission (inattention) increased (1.67). The largest decrease in errors of commission (impulsivity) was among the experimental group (-1.37), while the largest increase in errors of

omission (inattention) was among the control group (3.17). Total sample TOVA auditory post-test response times decreased by 15.63 milliseconds, from 676.45 to 660.82, with the largest decrease among the experimental group (-19.63).

Table 4-2

*Mean Auditory TOVA Error Scores of the Total Sample, Experimental, and Control Groups (N=60)*

Score	Experimental Group		Control Group		Total Sample	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Auditory (Commission)						
Pre-Test	5.31	3.86	4.38	2.78	4.84	3.37
Post-Test	3.94	3.10	3.6	2.72	3.80	2.90
Difference	-1.37	2.26	-.71	2.74	-1.04	2.51
Auditory (Omission)						
Pre-Test	10.44	12.35	9.49	11.73	9.97	11.95
Post-Test	10.61	12.93	12.66	19.08	11.64	16.19
Difference	.16	11.65	3.17	15.61	1.67	13.74

As shown in Table 4-3, total sample TOVA visual errors of commission (impulsivity) decreased for the total sample (-1.46), while errors of omission (inattention) increased (2.23). The largest decrease in errors of commission (impulsivity) was among the experimental group (-2.32), while the largest increase in errors of omission (inattention) was among the control group (3.16). Total sample TOVA visual post-test

response times increased by 38.40 milliseconds, from 511.57 to 549.97, with the smallest increase among the experimental group (13.93).

Table 4-3

*Mean Visual TOVA Error Scores of the Total Sample, Experimental, and Control Groups (N=60)*

Score	Experimental Group		Control Group		Total Sample	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Visual Commission (Impulsivity)						
Pre-Test	9.21	7.26	5.73	3.86	7.47	6.03
Post-Test	6.89	6.28	5.13	4.98	6.01	5.69
Difference	-2.32	4.01	-.60	4.70	-1.46	4.42
Visual Omission (Inattention)						
Pre-Test	4.89	6.38	3.21	3.92	4.05	5.32
Post-Test	6.19	7.55	6.37	8.77	6.28	8.11
Difference	1.31	4.13	3.16	6.50	2.23	5.15

As indicated in Table 4-4, total sample TOVA auditory response time decreased for the total sample (-15.63), while TOVA visual response time for the total sample increased (38.40). The largest decrease in auditory response time was among the experimental group (-19.63 milliseconds), while the largest increase in visual response time was among the control group (62.87 milliseconds).

Table 4-4

*Mean Response Time TOVA Scores of the Total Sample, Experimental, and Control Groups (N=60)*

Score	Experimental Group		Control Group		Total Sample	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Response Time (Auditory)						
Pre-Test	646.60	108.26	706.30	165.95	676.45	142.14
Post-Test	626.97	124.05	694.67	153.71	660.82	142.62
Difference	-19.63	69.17	-11.63	93.07	-15.63	81.40
Response Time (Visual)						
Pre-Test	520.63	104.96	502.50	136.78	511.57	121.22
Post-Test	534.57	84.72	565.37	133.82	549.97	112.12
Difference	13.93	72.20	62.87	68.50	38.40	74.01

***Research Question 3: Descriptive Characteristics and TOVA Scores***

*What is the relative contribution of the gender, age, estimated grade level, and BASC classification of second through fifth grade students with attention difficulties in explaining their TOVA scores?*

Multiple regression analyses were conducted for the total sample, experimental group, and control group for each of the three TOVA skills tests (auditory, visual and response time) by pre-test, post-test, and the difference between pre-test and post-test error scores.

Estimated grade level was removed after initial analysis showed a high correlation ( $r > .9$ ) between age and estimated grade level. For analyses related to total sample



auditory skills, results of multiple regression analyses found significant models for auditory pre-test percentage of commission (impulsivity) error scores, the difference between pre-test and post-test commission (impulsivity) error scores, and pre-test and post-test response time. For analyses related to total sample visual skills, significant models were found for pre-test and post-test response time.

### ***Descriptive Characteristics and Total Sample TOVA Auditory Skills Test Scores***

***Total sample pre-test TOVA auditory skills test percentage of commission (impulsivity) error scores.*** The  $F$  value (5.31) for the regression model analyzing total sample characteristics and the pre-test TOVA auditory skills errors of commission (impulsivity) scores was significant ( $p = .003$ ) for an explanatory relationship. The adjusted  $R^2$  indicated student characteristics accounted for 18.0% of the variance in their pre-test TOVA auditory skills errors of commission (impulsivity) scores. The  $t$ -statistic indicated gender, age, and BASC classification were significant explanatory variables of total sample pre-test TOVA auditory skills errors of commission (impulsivity). The size of the  $t$ -statistic signified age had the greatest impact on the model ( $t = -3.22, p = .002$ ), followed by gender ( $t = -2.05, p = .045$ ), and BASC classification ( $t = 2.02, p = .049$ ). The beta values for the first two explanatory variables, age ( $\beta = -.38$ ) and gender ( $\beta = -.24$ ) were negative, symbolizing an inverse relationship between the two explanatory variables and pre-test TOVA auditory percentage of commission (impulsivity) error scores. The inverse relationship indicated that lower pre-test errors of commission (impulsivity) were associated with older students and female students, while higher pre-test errors of commission (impulsivity) were associated with males and younger students. The beta value for the third explanatory variable, BASC classification ( $\beta = .24$ ) was

positive, indicating a positive relationship between BASC classification and pre-test, such that lower pre-test errors were associated with students classified as at-risk, while higher pre-test errors were associated with students classified as clinically significant. Table 4-5 summarizes the results of analysis of the relative contribution of student characteristics in explaining students' pre-test TOVA auditory skills errors of commission (impulsivity) scores.

Table 4-5

*Summarized Regression Analysis of Gender, Age, and BASC Classification in Explaining Student Pre-Test TOVA Auditory Skills Test Percentage of Commission (Impulsivity) Error Scores for the Total Sample (N=60)*

Variable	B	SE	$\beta$	t	p
(Constant)	12.84	3.10			
Gender	-1.76	0.86	-.24	-2.05	.05
Age	-0.90	0.28	-.38	-3.22	.00
BASC Classification	1.66	0.82	.24	2.01	.05
<hr/>					
N=60					
F=5.31	df=3	p=.003	R <sup>2</sup> =.22	Adjusted R <sup>2</sup> = .18	

*Total sample pre-test vs. post-test TOVA auditory skills test percentage of commission (impulsivity) error scores.* The *F* value (3.39) for the regression model analyzing total sample characteristics and the difference between pre-test and post-test TOVA auditory skills errors of commission (impulsivity) scores was significant ( $p = .024$ ) for an explanatory relationship. The adjusted  $R^2$  indicated student characteristics accounted for 10.9% of the variance in the difference between their pre-test and post-test

TOVA auditory skills errors of commission (impulsivity) scores. The *t*-statistic indicated age was a significant explanatory variable of the difference between total sample pre-test and post-test TOVA auditory skills errors of commission (impulsivity). The beta value for age ( $\beta = .34$ ) was positive, indicating a positive relationship between student age and the difference between pre-test and post-test TOVA auditory percentage of commission (impulsivity) error scores. The positive relationship indicated smaller differences between pre-test and post-test percentage of commission (impulsivity) errors were associated with younger students, while greater differences between pre-test and post-test percentage of errors of commission (impulsivity) were associated older students. Table 4-6 summarizes the results of analysis of the relative contribution of student characteristics in explaining the difference between total sample pre-test and post-test TOVA auditory skills errors of commission (impulsivity) scores.

Table 4-6

*Summarized Regression Analysis of Gender, Age, and BASC Classification in Explaining Differences in Student Pre-test vs. Post-test TOVA Auditory Skills Test Percentage of Commission (Impulsivity) Error Scores for the Total Sample (N=60)*

Variable	B	SE	$\beta$	t	p
(Constant)	-8.10	2.41			
Gender	1.29	0.67	.24	1.92	.06
Age	0.59	0.22	.34	2.70	.01
BASC Classification	-0.60	0.64	-.01	-0.09	.93
<div> <div>N=60</div> <div>F=3.39</div> <div>df=3</div> <div>p=.024</div> <div>R<sup>2</sup>=.15</div> <div>Adjusted R<sup>2</sup>= .11</div> </div>					

*Total sample pre-test TOVA auditory skills test response time scores.* The  $F$  value (2.80) for the regression model analyzing total sample characteristics and their pre-test auditory skills response time was significant ( $p = .048$ ) for an explanatory relationship. The adjusted  $R^2$  indicated student characteristics accounted for 8.4% of the variance in their pre-test TOVA auditory skills response time scores. The  $t$ -statistic indicated age was a significant explanatory variable of pre-test TOVA auditory skills response time scores. The beta value for age ( $\beta = -.34$ ) was negative, indicating an inverse relationship between student age and pre-test TOVA auditory skills response time scores. The inverse relationship indicated lower response time scores were associated with older students, while higher response time scores were associated younger students. Table 4-7 summarizes the results of analysis of the relative contribution of student characteristics in explaining students' pre-test TOVA auditory skills response time scores.

Table 4-7

*Summarized Regression Analysis of Gender, Age, and BASC Classification in Explaining Pre-test TOVA Auditory Skills Test Response Time Scores for the Total Sample (N=60)*

Variable	<i>B</i>	<i>SE</i>	$\beta$	<i>t</i>	<i>p</i>
(Constant)	914.79	138.20			
Gender	18.61	38.53	.06	0.48	.63
Age	-34.17	12.52	-.34	-2.73	.01
BASC Classification	33.80	36.74	.12	0.92	.36
<hr/>					
<b>N=60</b>					
<b>F=2.80</b>	<b>df=3</b>	<b>p=.048</b>	<b>R<sup>2</sup>=.13</b>	<b>Adjusted R<sup>2</sup>= .08</b>	

*Total sample post-test TOVA auditory skills test response time scores.* The  $F$  value (2.83) for the regression model analyzing total sample characteristics and their post-test auditory skills response time was significant ( $p = .047$ ) for an explanatory relationship. The adjusted  $R^2$  indicated student characteristics accounted for 8.5% of the variance in their post-test TOVA auditory skills response time scores. The  $t$ -statistic indicated age was a significant explanatory variable of post-test TOVA auditory skills response time scores. The beta value for age ( $\beta = -.34$ ) was negative, indicating an inverse relationship between student age and post-test TOVA auditory skills response time scores. The inverse relationship indicated lower response time scores were associated with older students, while higher response time scores were associated younger students. Table 4-8 summarizes the results of analysis of the relative contribution of student characteristics in explaining students' post-test TOVA auditory skills response time scores.

Table 4-8

*Summarized Regression Analysis of Gender, Age, and BASC Classification in Explaining Post-test TOVA Auditory Skills Test Response Time Scores for the Total Sample (N=60)*

Variable	$B$	$SE$	$\beta$	$t$	$p$
(Constant)	898.82	138.58			
Gender	8.63	38.64	.03	0.22	.82
Age	-34.35	12.56	-.34	-2.74	.01
BASC Classification	42.97	36.84	.15	1.17	.25
<hr/>					
<b>N=60</b>					
<b>F=2.83</b>	<b>df=3</b>	<b>p=.047</b>	<b>R<sup>2</sup>=.13</b>	<b>Adjusted</b>	<b>R<sup>2</sup>= .09</b>

*Experimental group pre-test vs. post-test TOVA auditory skills test percentage of commission (impulsivity) error scores.* The  $F$  value (3.89) for the regression model analyzing experimental group characteristics and the difference between pre-test and post-test TOVA auditory skills errors of commission (impulsivity) scores was significant ( $p = .020$ ) for an explanatory relationship. The adjusted  $R^2$  indicated characteristics of students in the experimental group accounted for 23.0% of the variance in the difference between their pre-test and post-test TOVA auditory skills errors of commission (impulsivity) scores. The  $t$ -statistic indicated gender was a significant explanatory variable of the difference between the experimental group's pre-test and post-test TOVA auditory skills errors of commission (impulsivity). The beta value for gender ( $\beta = .43$ ) was positive, indicating a positive relationship between student gender and the difference between pre-test and post-test TOVA auditory percentage of commission (impulsivity) error scores. The positive relationship indicated smaller differences between pre-test and post-test percentage of commission (impulsivity) errors were associated with male students, while greater differences between pre-test and post-test percentage of errors of commission (impulsivity) were associated female students. Table 4-9 summarizes the results of analysis of the relative contribution of student characteristics in explaining the difference between the experimental group's pre-test and post-test TOVA auditory skills errors of commission (impulsivity) scores.

Table 4-9

*Summarized Regression Analysis of Gender, Age, and BASC Classification in Explaining Differences in Pre-Test vs. Post-test TOVA Auditory Skills Test Percentage of Commission (Impulsivity) Error Scores for the Experimental Group (N=30)*

Variable	B	SE	$\beta$	t	p
(Constant)	-9.52	2.74			
Gender	1.93	0.74	.43	2.60	.02
Age	0.56	0.29	.34	1.94	.06
BASC Classification	0.12	0.80	.03	0.15	.88
<hr/>					
N=30					
F=3.89	df=3	p=.020	R <sup>2</sup> =.31	Adjusted R <sup>2</sup> = .23	

***Descriptive Characteristics and Total Sample TOVA Visual Skills Test Scores***

*Total sample pre-test TOVA visual skills test response time.* The *F* value (4.27) for the regression model analyzing total sample characteristics and the pre-test TOVA visual skills test response time was significant ( $p = .009$ ) for an explanatory relationship. The adjusted  $R^2$  indicated student characteristics accounted for 14.3% of the variance in their pre-test TOVA visual skills response time scores. The *t*-statistic indicated age was a significant explanatory variable ( $t = -3.18$ ,  $p = .002$ ) of total sample pre-test TOVA visual skills response time and the negative beta value ( $\beta = -.39$ ) indicated an inverse relationship between age and pre-test TOVA visual skills response time scores, such that younger participants had higher response times, while older participants had shorter response times. Table 4-10 summarizes the results of analysis of the relative contribution of student characteristics in explaining students' pre-test TOVA visual skills response time scores.

Table 4-10

*Summarized Regression Analysis of Gender, Age, and BASC Classification in Explaining Student Pre-Test TOVA Visual Skills Test Response Time Scores for the Total Sample (N=60)*

Variable	B	SE	$\beta$	t	p
(Constant)	716.47	114.01			
Gender	36.30	31.79	.14	1.14	.26
Age	-32.87	10.33	-.39	-3.18	.00
BASC Classification	32.79	30.31	.13	1.08	.28
N=60 F=4.27	df=3	p=.009	R <sup>2</sup> =.19	Adjusted R <sup>2</sup> = .14	

**Total sample post-test TOVA visual skills test response time.** The *F* value (3.19) for the regression model analyzing total sample characteristics and the post-test TOVA visual skills test response time was significant ( $p = .03$ ) for an explanatory relationship. The adjusted  $R^2$  indicated student characteristics accounted for 10.0% of the variance in their pre-test TOVA visual skills response time scores. The *t*-statistic indicated age was a significant explanatory variable ( $t = -2.59$ ,  $p = .012$ ) of total sample post-test TOVA visual skills response time and the negative beta value ( $\beta = -.32$ ) indicated an inverse relationship between age and post-test TOVA visual skills response time scores, such that younger participants had higher response times, while older participants had shorter response times. BASC classification had marginally significant ( $p = .052$ ) positive relationship with post-test TOVA visual response time scores, such that response times were higher for students classified as clinically significant and lower for those classified as at risk. Table 4-11 summarizes the results of analysis of the relative contribution of



student characteristics in explaining students' pre-test TOVA visual skills response time scores.

Table 4-11

*Summarized Regression Analysis of Gender, Age, and BASC Classification in Explaining Student Post-Test TOVA Visual Skills Test Response Time Scores for the Total Sample (N=60)*

Variable	B	SE	$\beta$	t	p
(Constant)	701.10	108.02			
Gender	-6.73	30.12	-.03	-0.22	.82
Age	-25.33	9.79	-.32	-2.59	.01
BASC Classification	57.04	28.71	.25	1.99	.05
<hr/>					
N=60					
F=3.19	df=3	p=.030	R <sup>2</sup> =.15	Adjusted R <sup>2</sup> = .10	

### Hypotheses

#### *Hypothesis 1: Experimental Group's TOVA Auditory Scores*

*Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of error scores.*

H<sub>1a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of commission (impulsivity) error scores.

H<sub>1b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have

a significant decrease in their TOVA auditory skills test percentage of omission (inattention) error scores.

The results of paired samples (within group) *t*-tests showed on average, students in the experimental group had a significant decrease in the percentage of TOVA auditory skills test errors of commission (impulsivity) when comparing their pre-test ( $M = 5.31$ ,  $SE = .71$ ) and post-test ( $M = 3.94$ ,  $SE = .57$ ,  $t(29) = 3.33$ ,  $p < .05$ ,  $r = .53$ ) scores. Moreover, the calculated effect size,  $r = .53$ , indicated a large change (Field, 2005) in percentage of error of commission (impulsivity) scores was experienced by those students who participated in the seven-week World Music Drumming program. There was no significant decrease in the percentage of TOVA auditory skills test errors of omission (inattention) among students in the experimental group ( $p = .939$ ). Results indicated  $H_{1a}$  was supported, but  $H_{1b}$  was not. Table 4-12 shows the results of the dependent *t*-test analyses of the experimental group's pre-test and post-test TOVA auditory skills test errors of commission (impulsivity) and omission (inattention).

Table 4-12

*Experimental Group Mean Comparison Between Pre-Test and Post-Test TOVA Auditory Skills Test Percentage of Error Scores*

<b>Group and Variable</b>	<b>N</b>	<b>Pre- (time x1) Mean</b>	<b>Post- (time x2) Mean</b>	<b>Diff</b>	<b><i>t</i>-value</b>	<b><i>p</i>-value</b>
Auditory Commission	30	5.31	3.94	-1.37	3.33	.002
Auditory Omission	30	10.44	10.61	0.16	-.077	.939

### ***Hypothesis 1: Experimental Group's TOVA Auditory Scores,***

#### ***Nonparametric Analyses***

Although results of parametric tests showed  $H_{1a}$  was supported, because a review of the histogram for the total sample's TOVA auditory skills test showed the distribution of scores was non-normal, student's scores were tested to see if the distributions were normal, as well as for homogeneity of variance. Results of Levene's test showed variances were not significantly different for the experimental group on either the errors of commission (impulsivity) or errors of omission (inattention) scores. However, results of the Shapiro-Wilk test showed sample distributions deviated from normal for all of the experimental group's auditory skills test percentage of error scores. For the scores reflecting the percentage of errors of commission (impulsivity), the experimental group's pre-test,  $W(30) = .91, p < .05$ , and experimental group's post-test,  $W(30) = .89, p < .05$ , scores on the TOVA auditory skills test were all significantly non-normal. For the scores reflecting the percentage of errors of omission (inattention), the experimental group's pre-test,  $W(30) = .72, p < .001$ , and experimental group's post-test,  $W(30) = .70, p < .001$ , were also significantly non-normal.

Based on these findings, nonparametric tests were also conducted to test  $H_{1a}$  and  $H_{1b}$ . As with the parametric paired samples  $t$ -test, significant differences were found only for the experimental group's percentage of errors of commission (impulsivity) scores. Results from the Wilcoxon signed-rank test showed the experimental group's percentage of TOVA auditory skills errors of commission (impulsivity) were significantly lower on the post-test (3.66) than on the pre-test (4.38),  $T=97, p < .05, r = .51$ . Based on the calculated effect size,  $r = .51$  (Field, 2005), results of nonparametric analysis also

indicated a large change in percentage of error of commission (impulsivity) scores was experienced by those students who participated in the seven-week World Music Drumming program.

***Hypothesis 2: Experimental Group's TOVA Visual Scores***

*Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of error scores.*

H<sub>2a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores.

H<sub>2b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of omission (inattention) error scores.

The results of paired samples (within group) *t*-tests showed on average, students in the experimental group had a significant decrease in the percentage of TOVA visual skills test errors of commission (impulsivity) when comparing their pre-test ( $M = 9.21$ ,  $SE = 1.33$ ) and post-test ( $M = 6.89$ ,  $SE = 1.15$ ,  $t(29) = 3.18$ ,  $p < .05$ ,  $r = .51$ ) scores. Moreover, the calculated effect size,  $r = .51$ , indicated a large change (Field, 2005) in percentage of error of commission (impulsivity) scores was experienced by those students who participated in the seven-week World Music Drumming program. There was no significant decrease ( $p = .094$ ) in the percentage of TOVA visual skills test errors

of omission (inattention) among students in the experimental group; post-test scores ( $M = 6.19, SE = 1.38$ ) were actually higher than pre-test scores ( $M = 4.89, SE = 1.17$ ). Results indicated  $H_{2a}$  was supported, but  $H_{2b}$  was not. Table 4-13 shows the results of the dependent  $t$ -test analyses of the experimental group's pre-test and post-test TOVA visual skills test errors of commission (impulsivity) and omission (inattention).

Table 4-13

*Experimental Group Mean Comparison Between Pre-Test and Post-Test TOVA Visual Skills Test Percentage of Error Scores*

Group and Variable	N	Pre- (time x1) Mean	Post- (time x2) Mean	Diff	t-value	p-value
Visual Commission	30	9.21	6.89	-2.32	3.18	.004
Visual Omission	30	4.89	6.19	1.31	-1.73	.094

***Hypothesis 2: Experimental Group's TOVA Visual Scores,***

***Nonparametric Analyses***

Although results of parametric tests showed  $H_{1a}$  was supported, students' scores were tested to see if the distributions were normal, as well as for homogeneity of variance. Results of the Shapiro-Wilk test showed sample distributions deviated from normal for all of the experimental group's visual skills test percentage of error scores. Results of Levene's test showed variances were not significantly different for the experimental group on either the errors of commission (impulsivity) or errors of omission (inattention) scores.

For the scores reflecting the percentage of errors of commission (impulsivity), the experimental group's pre-test,  $W(30) = .74, p < .001$  and experimental group's post-test,  $W(30) = .82, p < .001$ , the distribution of scores on the TOVA visual skills test were all significantly non-normal. For the scores reflecting the percentage of errors of omission (inattention), the experimental group's pre-test,  $W(30) = .67, p < .001$ , and experimental group's post-test,  $W(30) = .78, p < .001$ , were also significantly non-normal.

Based on these findings, nonparametric tests were also conducted to test  $H_{2a}$  and  $H_{2b}$ . As with the parametric paired samples  $t$ -test, significant differences were found only for the experimental group's percentage of errors of commission (impulsivity) scores. Results from the Wilcoxon signed-rank test showed the experimental group's percentage of TOVA visual skills errors of commission (impulsivity) were significantly lower on the post-test (6.89) than on the pre-test (9.21),  $T=79, p < .05, r = .58$ . Based on the calculated effect size,  $r = .58$  (Field, 2005), results of nonparametric analysis also indicated a large change in percentage of error of commission (impulsivity) scores was experienced by those students who participated in the seven-week World Music Drumming program. No significant difference was found for the TOVA visual skills test percentage of omission (inattention) errors ( $p = .264$ ).

### ***Hypothesis 3: Experimental Group's TOVA Response Time***

*Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA response time scores.*

$H_{3a}$  Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have

a significant decrease in their TOVA auditory skills test response time scores.

H<sub>3b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual response time scores.

The results of paired samples (within group) *t*-tests showed on average, students in the experimental group did not have a significant decrease in their TOVA auditory response time scores when comparing their pre-test ( $M = 646.60$ ,  $SE = 19.77$ ) and post-test ( $M = 626.97$ ,  $SE = 22.65$ ,  $t(29) = 1.56$ ,  $p > .05$ ,  $r = .28$ ) scores. There was also no significant decrease in their TOVA visual response time scores when comparing their pre-test ( $M = 520.63$ ,  $SE = 19.16$ ) and post-test ( $M = 534.57$ ,  $SE = 15.47$ ,  $t(29) = -1.06$ ,  $p > .05$ ,  $r = .19$ ) scores. Results indicated neither H<sub>3a</sub> nor H<sub>3b</sub> was supported. Table 4-14 shows the results of the dependent *t*-test analyses of the experimental group's pre-test and post-test TOVA auditory and visual skills test response time scores.

Table 4-14

*Experimental Group TOVA Response Time Scores*

Group and Variable	N	Pre-(time x1) Mean	Post-(time x2) Mean	Diff	<i>t</i> -value	<i>p</i> -value
Auditory Response Time	30	646.60	626.97	19.63	1.56	.13
Visual Response Time	30	520.63	534.57	-13.93	-1.06	.30

### ***Hypothesis 3: Experimental Group's TOVA Response Time,***

#### ***Nonparametric Analyses***

The experimental group's scores were tested using the Shapiro-Wilk test to see if the distributions were normal. For the auditory response time skills test, the Shapiro-Wilk test indicated only the post-test distribution deviated from normal,  $W(30) = .93, p < .05$ . Results of the Shapiro-Wilk test showed the sample distribution for the experimental group's TOVA visual skills test response times did not deviate from normal for either the pre-test ( $p = .081$ ) or post-test ( $p = .192$ ). However, Levene's test for the homogeneity of variance indicated variances among the total sample did differ significantly for the post-test visual skills response time,  $F(1, 58) = 7.54, p < .05$ .

Based on these findings, nonparametric tests (Wilcoxon signed-rank test) were also conducted to test  $H_{3b}$  but no significant decrease in the experimental group's TOVA visual skills test response time score was found ( $p = .176$ ). The experimental group's TOVA auditory skills test response time score was marginally significant ( $p = .054$ ).

### ***Hypothesis 4: Control Group's TOVA Auditory Scores***

*Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of error scores.*

$H_{4a}$  Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of commission (impulsivity) error test scores.



H<sub>4b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of omission (inattention) error test scores.

The results of paired samples (within group) *t*-tests showed on average, students in the control group did not have a significant decrease in the percentage of TOVA auditory skills test errors of commission (impulsivity) when comparing their pre-test ( $M = 4.38, SE = .51$ ) and post-test ( $M = 3.66, SE = .50, t(29) = 1.43, p > .05, r = .26$ ) scores. Based on this finding, H<sub>4a</sub> was supported. There was also no significant decrease in the percentage of TOVA auditory skills test errors of omission (inattention) among students in the control group when comparing their pre-test ( $M = 9.49, SE = 2.14$ ) and post-test ( $M = 12.66, SE = 3.48, t(29) = -1.11, p > .05, r = .20$ ) scores. Post-test scores showed a non-significant increase in the percentage of error scores. Based on this finding, H<sub>4b</sub> was also supported. Table 4-15 shows the results of the dependent *t*-test analyses of the control group's pre-test and post-test TOVA auditory skills test errors of commission (impulsivity) and omission (inattention).

Table 4-15

*Control Group Mean Comparison Between Pre-Test and Post-Test TOVA Auditory Skills Test Percentage of Error Scores*

Group and Variable	N	Pre- (time x1) Mean	Post- (time x2) Mean	Diff	<i>t</i> -value	<i>p</i> -value
Auditory Commission	30	4.38	3.66	.71	1.43	.16
Auditory Omission	30	9.49	12.66	-3.17	-1.11	.28

#### ***Hypothesis 4: Control Group's TOVA Auditory Scores,***

##### ***Nonparametric Analyses***

Although results of parametric tests showed both  $H_{4a}$  and  $H_{4b}$  were supported, because a review of the histogram for the total sample's TOVA auditory skills test showed the distribution of scores was non-normal, students' scores were tested to see if the distributions were normal, as well as for homogeneity of variance. Results of Levene's test showed variances were not significantly different for either the errors of commission (impulsivity) or errors of omission (inattention) scores of the control group. However, results of the Shapiro-Wilk test showed sample distributions for the control group deviated from normal for all but the control group's pre-test errors of commission (impulsivity) data. For the scores reflecting the percentage of errors of commission (impulsivity), the control group's post-test,  $W(30) = .90, p < .05$  scores on the TOVA auditory skills test were significantly non-normal. For the scores reflecting the percentage of errors of omission (inattention), the control groups' pre-test,  $W(30) = .76, p < .001$ , and control group's post-test,  $W(30) = .64, p < .001$ , were also significantly non-normal.

Based on these findings, nonparametric tests were also conducted to test  $H_{4a}$  and  $H_{4b}$ . As with the parametric paired samples  $t$ -test, no significant decreases were found for either the percentage of commission (impulsivity) or omission (inattention) errors between the control groups' TOVA auditory skills pre-test and post-test.

### ***Hypothesis 5: Control Group's TOVA Visual Scores***

*Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test scores.*

H<sub>5a</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test percentage of commission (impulsivity) error test scores.

H<sub>5b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant increase in their TOVA visual skills test percentage of omission (inattention) error test scores.

The results of paired samples (within group) *t*-tests showed on average, students in the control group did not have a significant decrease in the percentage of TOVA visual skills test errors of commission (impulsivity) when comparing their pre-test ( $M = 5.73$ ,  $SE = .70$ ) and post-test ( $M = 5.13$ ,  $SE = .91$ ,  $t(29) = .70$ ,  $p > .05$ ,  $r = .13$ ) scores. Based on this finding, H<sub>5a</sub> was supported. While there was no significant decrease, there was a significant increase in the percentage of TOVA visual skills test errors of omission (inattention) among students in the control group when comparing their pre-test ( $M = 3.21$ ,  $SE = 0.72$ ) and post-test ( $M = 6.34$ ,  $SE = 1.60$ ,  $t(29) = -2.92$ ,  $p < .05$ ,  $r = .48$ ) scores. Based on this finding, H<sub>5b</sub> was also supported. Table 4-16 shows the results of the dependent *t*-test analyses of the control group's pre-test and post-test TOVA visual skills test errors of commission (impulsivity) and omission (inattention).

Table 4-16

*Control Group Mean Comparison Between Pre-Test and Post-Test TOVA Visual Skills  
Test Percentage of Error Scores*

Group and Variable	N	Pre- (time x1) Mean	Post- (time x2) Mean	Diff	t-value	p-value
Visual Commission	30	5.73	5.13	-0.60	0.70	.49
Visual Omission	30	3.721	6.37	3.16	-2.92	.01

*Hypothesis 5: Control Group's TOVA Visual Scores,*

*Nonparametric Analyses*

Although results of parametric tests showed both  $H_{5a}$  and  $H_{5b}$  were supported, students' scores were tested to see if the distributions were normal, as well as for homogeneity of variance. Results of Levene's test showed variances were not significantly different for either the errors of commission (impulsivity) or errors of omission (inattention) scores of the control group. However, results of the Shapiro-Wilk test showed sample distributions for the control group deviated from normal for both the percentage of commission (impulsivity) and omission (inattention) errors. For the scores reflecting the percentage of errors of commission (impulsivity), the control group's pre-test,  $W(30) = .90, p < .05$  and control group's post-test,  $W(30) = .82, p < .001$  scores on the TOVA visual skills test were both significantly non-normal. For the scores reflecting the percentage of errors of omission (inattention), the control group's pre-test,  $W(30) =$

.77,  $p < .001$ , and control group's post-test,  $W(30) = .71$ ,  $p < .001$ , were also significantly non-normal.

Based on these findings, nonparametric tests were also conducted to test  $H_{5a}$  and  $H_{5b}$ . Results from the Wilcoxon signed-rank test showed the control groups' percentage of TOVA visual skills errors of commission (impulsivity) were significantly lower on the post-test (5.13) than on the pre-test (5.73),  $T=136.50$ ,  $p < .05$ ,  $r = .36$ . Based on the calculated effect size,  $r = .36$  (Field, 2005), results of nonparametric analysis also indicated a medium change in percentage of error of commission (impulsivity) scores was experienced by those students who participated in the seven-week World Music Drumming program. No significant decrease was found for the TOVA visual skills test percentage of omission (inattention) errors. However, there was a significant increase between the pre-test (3.21) and the post-test (6.36),  $T = 80$ ,  $p < .05$ ,  $r = .51$ . Results of nonparametric tests indicate  $H_{5a}$  was not supported, while  $H_{5b}$  was supported.

#### ***Hypothesis 6: Control Group's TOVA Response Time***

*Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA response time scores.*

$H_{6a}$  Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory response time scores.

$H_{6b}$  Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual response time scores.

The results of paired samples (within group) *t*-tests showed on average, students in the control group did not have a significant decrease in their TOVA auditory response time scores when comparing their pre-test ( $M = 706.30$ ,  $SE = 30.30$ ) and post-test ( $M = 694.67$ ,  $SE = 28.06$ ,  $t(29) = 0.69$ ,  $p > .05$ ,  $r = .13$ ) scores. While there was also no significant decrease in their TOVA visual response time scores when comparing their pre-test ( $M = 502.50$ ,  $SE = 24.97$ ) and post-test ( $M = 565.37$ ,  $SE = 24.43$ ,  $t(29) = -5.03$ ,  $p < .001$ ,  $r = .68$ ) scores, there was a significantly large increase. Results indicated both  $H_{6a}$  and  $H_{6b}$  were supported. Table 4-17 shows the results of the dependent *t*-test analyses of the control group's pre-test and post-test TOVA auditory and visual skills test response time scores.

Table 4-17

*Control Group TOVA Response Time Scores*

<b>Group and Variable</b>	<b>N</b>	<b>Pre- (time x1) Mean</b>	<b>Post- (time x2) Mean</b>	<b>Diff</b>	<b><i>t</i>-value</b>	<b><i>p</i>-value</b>
Auditory Response Time	30	706.30	694.67	11.63	.685	.50
Visual Response Time	30	502.5	565.37	62.87	-5.03	.00

### ***Hypothesis 6: Control Group's TOVA Response Time,***

#### ***Nonparametric Analyses***

The control groups' scores were tested using the Shapiro-Wilk test to see if the distributions were normal. For both the auditory and visual response time skills test, the Shapiro-Wilk test indicated all the control groups' distributions were normally distributed. Levene's test for the homogeneity of variance indicated variances among the total sample's auditory response time skills test did not differ significantly; however variances for the post-test visual skills response time did differ significantly,  $F(1, 58) = 7.54, p < .05$ .

Based on these findings, nonparametric tests (Wilcoxon signed-rank test) were also conducted to test  $H_{6a}$  and  $H_{6b}$ . No significant decrease in the control group's TOVA auditory skills test response time was found ( $p = .484$ ). While no significant decrease was found for the TOVA visual skills test response time, there was a significantly large increase between the pre-test (502.50) and post-test (565.37) scores,  $T = 423.50, p < .001, r = .72$ .

### ***Hypothesis 7: Differences in TOVA Auditory Scores***

*Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.*

$H_{7a}$  Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have

a significantly greater decrease in their TOVA auditory skills test percentage of commission (impulsivity) error test scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

- H<sub>7b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills percentage of omission (inattention) error test scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

On average, students who participated in the seven-week World Music Drumming program experienced a greater decrease in their TOVA auditory skills percentage of commission (impulsivity) errors score ( $M = -1.37$ ,  $SE = .42$ ) than did those students who did not participate in the program ( $M = -0.71$ ,  $SE = .41$ ). This difference was not significant  $t(58) = 1.01$ ,  $p > .05$ , nor did it represent a substantive effect  $r = .13$ . Neither group experienced a decrease in their TOVA auditory skills percentage of omission (inattention) error scores. Although increases were lower among the students who participated in the seven-week World Music Drumming program ( $M = 0.16$ ,  $SE = 2.13$ ) than for those who did not participate in the program ( $M = 3.17$ ,  $SE = 2.85$ ), the difference was not significant  $t(58) = 0.85$ ,  $p > .05$ , nor did it represent a substantive effect  $r = .11$ . Nonparametric results were consistent with parametric analyses. Based on



these results, neither  $H_{7a}$  nor  $H_{7b}$  were supported. Table 4-18 shows the results of the comparison between the experimental and control group's TOVA auditory scores.

Table 4-18

*Comparison Between Experimental and Control Group TOVA Auditory Scores*

Group and Variable	N	Pre- (time x1) Mean	Post- (time x2) Mean	Diff (Post – Pre)	Diff (Exp – Control)	t-value	p-value
Auditory Commission							
Experimental Group	30	5.31	3.94	-1.37			
Control Group	30	4.38	3.66	-0.71	0.66	1.01	.16
Auditory Omission							
Experimental Group	30	10.44	10.61	0.16			
Control Group	30	9.49	12.66	3.17	3.01	0.85	.20

***Hypothesis 8: Differences in TOVA Visual Scores***

*Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.*

H<sub>8a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

H<sub>8b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of omission (inattention) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

On average, students who participated in the seven-week World Music Drumming program experienced a greater decrease in their TOVA visual skills percentage of commission (impulsivity) errors score ( $M = -2.32$ ,  $SE = .73$ ) than did those students who did not participate in the program ( $M = -.60$ ,  $SE = .86$ ). This difference was not significant  $t(58) = 1.53$ ,  $p > .05$ , nor did it represent a substantive effect  $r = .20$ . Neither group experienced a decrease in their TOVA visual skills test percentage of omission (inattention) error scores. Both groups experienced increases in scores. Although increases were lower among the students who participated in the seven-week World Music Drumming program ( $M = 1.31$ ,  $SE = .75$ ) than for those who did not participate in the program ( $M = 3.16$ ,  $SE = 1.08$ ), the difference was not significant  $t(58) = 1.40$ ,  $p >$

.05, nor did it represent a substantive effect  $r = .18$ . Nonparametric results were consistent with parametric analyses. Based on these results, neither  $H_{8a}$  nor  $H_{8b}$  were supported. Table 4-19 shows the comparison between the experimental and control group's TOVA visual scores.

Table 4-19

*Comparison Between Experimental and Control Group TOVA Visual Scores*

Group and Variable	N	Pre- (time x1) Mean	Post- (time x2) Mean	Diff (Post – Pre)	Diff (Exp – Control)	t-value	p-value
Visual Commission							
Experimental Group	30	9.21	6.89	-2.32			
					1.73	1.53	.13
Control Group	30	5.73	5.13	-.60			
Visual Omission							
Experimental Group	27	4.89	6.19	1.31			
					1.85	1.40	.17
Control Group	22	3.21	6.37	3.16			

### ***Hypothesis 9: Differences in TOVA Response Times***

*Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.*

H<sub>9a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

H<sub>9b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual response time scores than will Second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.

On average, students who participated in the seven-week World Music Drumming program experienced a greater decrease in their TOVA auditory skills response time scores ( $M = -19.63$ ,  $SE = 12.63$ ) than did those students who did not participate in the program ( $M = -11.63$ ,  $SE = 16.99$ ). This difference was not significant  $t(58) = 0.38$ ,  $p > .05$ , nor did it represent a substantive effect  $r = .07$ . Neither group experienced a

decrease in their TOVA visual skills response time scores. Both groups experienced increases in scores. Increases were lower among the students who participated in the seven-week World Music Drumming program ( $M = 13.93$ ,  $SE = 13.18$ ) than for those who did not participate in the program ( $M = 62.87$ ,  $SE = 12.51$ ). The difference was significant  $t(58) = -2.69$ ,  $p < .05$ , and represented a medium sized effect  $r = .44$ . Nonparametric results were consistent with parametric analyses. Based on these results, neither  $H_{9a}$  nor  $H_{9b}$  were supported. Table 4-20 shows the comparison between the experimental and control group's TOVA response time scores.

Table 4-20  
*Comparison Between Experimental and Control Group TOVA Response Time Scores*

Group and Variable	N	Pre- (time x1) Mean	Post- (time x2) Mean	Diff (Post – Pre)	Diff (Exp – Control)	t-value	p-value
Auditory Response Time							
Experimental Group	30	646.60	626.97	-19.63	8.00	0.38	.71
Control Group	30	706.30	694.67	-11.63			
Visual Response Time							
Experimental Group	30	520.63	534.57	13.93	48.93	-2.69	.01
Control Group	30	502.50	565.37	62.87			

## Summary

This quantitative, experimental, and causal-comparative study used dependent and independent *t*-tests to examine the effect of World Music Drumming on the auditory and visual attention skills of second through fifth grade students with attention difficulties in a South Florida elementary school. Using the entire accessible population for whom parental consent was obtained, random assignment was used to assign a total of 60 students, 42 males (68.9%) and 18 females (29.5%), with at-risk or clinically significant BASC classifications in the area of attention to participate in either the experimental or control group. Random assignment resulted in an experimental group of 30 students, 17 males (56.7%) and 13 females (43.3%), and a control group of 30 students, 25 males (83.3%) and 5 females (16.7%). The students ranged from second through fifth grade, ages 7 to 12 years. The total sample consisted of 22 students with at-risk BASC classifications (36.1%) and 38 students with clinically significant BASC classifications (62.3%). The experimental group consisted of 12 students (40%) labeled at-risk and 18 students (60%) labeled clinically significant. The control group consisted of 10 students (33.3%) labeled at-risk and 20 students (66.7%) labeled clinically significant.

The purpose of this study was to explore the relationship between World Music Drumming and auditory and visual attention skills of ADHD at-risk and clinically significant students at a South Florida elementary school. Three research questions described the sample and examined the influence of student characteristics on TOVA auditory and visual skills pre-test and post-test percentage of commission (impulsivity) error scores, omission (inattention) error scores, and response time scores. Table 4-21 lists the research purposes related to the research questions, and findings for each.

Table 4-21

*Research Purposes, Research Questions, and Results of the Study*

Research Purposes	Research Questions and Hypotheses	Results
1. Exploration of gender, age, estimated grade level, and BASC classification of the second through fifth grade students with attention difficulties who participated in this study.	RQ1. What are the gender, age, estimated grade level, and BASC classifications of the second through fifth grade students with attention difficulties who participated in this study?	Boys identified ADHD more often than girls; more students identified with ADHD as they grow older; more boys identified ADHD clinically significant than girls
2. Exploration of the pre-test and post-test TOVA auditory and visual percentage of error scores, and response time scores of the second through fifth grade students with attention difficulties who participated in this study.	RQ2. What are the pre-test and post-test TOVA auditory and visual percentage of error scores, and response time scores of the second through fifth grade students with attention difficulties who participated in this study?	Total sample: auditory errors of commission decreased while auditory errors of omission increased; visual errors of commission decreased while visual errors of omission increased; auditory response time scores decreased while visual response time scores increased
3. Exploration of the relative contribution of the gender, age, estimated grade level, and BASC classification of second through fifth grade students with attention difficulties in explaining their TOVA scores.	RQ3. What is the relative contribution of the gender, age, estimated grade level, and BASC classification of second through fifth grade students with attention difficulties in explaining their TOVA scores?	Age was most often an explanatory variable, but gender and BASC were also explanatory variables

Nine hypotheses tested for both within group and between group differences in terms of pre-test and post-test percentage of commission (impulsivity) error scores, omission (inattention) error scores and response time scores.

Table 4-22 lists the research purposes of the study related to within group differences among students, the related hypotheses, and the findings for each.

Table 4-22

*Research Purposes, Hypotheses, and Results of the Study*

Research Purposes	Hypotheses	Results
Examination of the difference in TOVA auditory and visual skills percentage of commission (impulsivity) error scores, omission (inattention) error scores, and response times between pre-test and post-test administration of second through fifth grade students with attention difficulties participated in the seven-week World Music Drumming program.	H1 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of error scores.	H <sub>1a</sub> supported; H <sub>1b</sub> not supported
	H2 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of error scores.	H <sub>2a</sub> supported; H <sub>2b</sub> not supported
	H3 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA response time scores.	H <sub>3a</sub> not supported; H <sub>3b</sub> not supported
Examination of the difference in TOVA auditory and visual skills percentage of commission (impulsivity) error scores, omission (inattention) error scores, and response times between pre-test and post-test administration of second through fifth grade students with attention difficulties who did not participate in the seven-week World Music Drumming program.	H4 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of error scores.	H <sub>4a</sub> supported; H <sub>4b</sub> supported
	H5 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test scores.	H <sub>5a</sub> supported, non-parametric analysis not supported; H <sub>5b</sub> supported
	H6 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA response time scores.	H <sub>6a</sub> supported; H <sub>6b</sub> supported



Table 4-23 lists the research purposes of the study related to between group differences among the students who participated and those who did not participate in the World Music Drumming program, the related hypotheses, and the findings for each.

Table 4-23

*Research Purposes, Hypotheses, and Results of the Study*

Research Purposes	Hypotheses	Results
Examination of the difference in TOVA auditory and visual skills percentage of commission (impulsivity) error scores, omission (inattention) error scores, and response times between pre-test and post-test administration between second through fifth grade students with attention difficulties who did participate in the seven-week World Music Drumming program and those who did not participate in the program.	H7 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	H <sub>7a</sub> not supported; H <sub>7b</sub> not supported
	H8 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	H <sub>8a</sub> not supported; H <sub>8b</sub> not supported
	H9 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	H <sub>9a</sub> not supported; H <sub>9b</sub> not supported

Chapter IV presented descriptive statistics of the sample, and reported the results of the examination of research questions and hypothesis testing. Additional analyses related to the research questions and hypotheses were also reported. Chapter V will present a discussion of the interpretations, limitations, practical implications, conclusions, and recommendations pertaining to this study, based on the literature and findings related to the effect of World Music Drumming on the auditory and visual attention skills of attention deficit hyperactivity disorder (ADHD) at risk or clinically significant elementary students.

## **CHAPTER V**

### **DISCUSSION**

Chapter V presents a discussion of the results reported in Chapter IV about the effect of participation in the seven-week World Music Drumming program on auditory and visual attention skills as measured using the TOVA, Auditory and Visual. Descriptive results and results of the exploration of the research questions and testing of the hypotheses are interpreted in light of the review of literature. Study limitations, practical implications, conclusions, and recommendations for future study are also presented in this chapter.

#### **Interpretations**

##### ***Research Questions***

In addition to reporting descriptive characteristics of the sample and sample responses to pre-test and post-test TOVA auditory and visual skills tests, this study analyzed the influence of student attribute variables (gender, age, estimated grade level, and BASC classification) on both the TOVA auditory and visual tests, including pre-test, post-test, and differences between pre-test and post-test scores. Analyses were conducted for the experimental and control groups, as well as for the total sample. Findings from the exploration of each research question were linked to the review of the literature whenever possible. Table 5-1 provides a list of the research questions explored in this study, and summarizes results of analyses and linkages to the literature.

Table 5-1

*Research Questions and Results*

Research Questions	Results	Literature	Consistent with Literature
RQ1. What are the gender, age, estimated grade level, and BASC classifications of the second through fifth grade students with attention difficulties who participated in this study?	Boys identified ADHD more often than girls; more students identified with ADHD as they grow older; more boys identified ADHD clinically significant than girls	August et al., 1996; Carlson et al., 1997; Gershon, 2002; Greenblatt, 1994; Silver, 1992; Wolraich et al., 1998; Zentall, 2006	Yes
RQ2. What are the pre-test and post-test TOVA auditory and visual skills test percentage of error scores, and response time scores of the second through fifth grade students with attention difficulties who participated in this study?	Total sample: auditory errors of commission decreased while auditory errors of omission increased; visual errors of commission decreased while visual errors of omission increased; auditory response time scores decreased while visual response time scores increased	Barkley, 1990; Cripe, 1986; Davies & Witte, 2000; Frick et al., 1991; Montello & Coons, 1998; Reif, 1993; Rickson, 2006; Shehan, 1981; Wilson, 1976	Yes
RQ3. What is the relative contribution of the gender, age, estimated grade level, and BASC classification of second through fifth grade students with attention difficulties in explaining their TOVA scores?	Age most often an explanatory variable, but gender and BASC also explanatory variables	August et al., 1996; Carlson et al., 1997; Gershon, 2002; Greenblatt, 1994; Silver, 1992; Wolraich et al., 1998; Wolraich et al., 1998; Zentall, 2006	Yes

### *Descriptive Characteristics of the Sample*

**Research question 1.** Research question 1 examined the gender, age, estimated grade level, and BASC classification of the second through fifth grade students with attention difficulties who participated in this study. Findings indicated the number of boys identified with attention difficulties (70.0%) was greater than the number of girls identified (30.0%) at a South Florida elementary school. Research cited in the review of literature supports this finding, suggesting gender is a factor in identifying children with ADHD. An average of four boys are identified with ADHD symptoms for every one girl identified with ADHD symptoms (August et al, 1996; Carlson et al., 1997; Gershon, 2002; Greenblatt, 1994; Wolraich et al., 1998; Zentall, 2006). There are several reasons this may be the case. Educational services available for students with attention difficulties can appear inappropriate for girls due to the majority of students identified being boys. Greenblatt (1994) studied gender bias in the assessment of ADHD and found teachers and counselors identified 27% of girl cases to have ADHD, compared to 72% of the boys.

For the total sample, the mean ages were age 7 (11.5%), age 8 (21.3%), age 9 (19.7%), age 10 (23.0%), age 11 (18.0%), and age 12 (4.9%), and consisted of seven students from second grade (11.5%), 13 students from third grade (21.3%), 12 students from fourth grade (19.7%), and 28 students from fifth grade (45.9%). Age and grade level composition of students in the sample suggest more students are identified with symptoms of ADHD as they grow older. Although the DSM-IV states that ADHD symptoms must be present prior to age seven, in reality the majority of children are not

diagnosed until intermediate elementary school, middle school, or even high school (Zentall, 2006).

The BASC classification of each student was labeled either at-risk or clinically significant in the area of attention. The total sample consisted of 22 students labeled at-risk (36.7%) and 38 students labeled clinically significant (63.3%). The experimental group consisted of 12 students (40%) labeled at-risk, four girls (13.3%) and eight boys (26.7%), and 18 students (60%) labeled clinically significant, nine girls (30.0%) and nine boys (30.0%). The control group consisted of 10 students (33.3%) labeled at-risk, two girls (6.7%) and eight boys (26.7%), and 20 students (66.7%) labeled clinically significant, three girls (10.0%) and 17 boys (56.7%). This finding supports conclusions from earlier research that girls typically do not manifest symptoms of ADHD in the same way as boys, resulting in less girls being identified with ADHD than boys (August et al., 1996; Carlson et al, 1997; Gershon, 2002; Greenblatt, 1994; Wolraich et al., 1998; Zentall, 2006).

### ***TOVA Error Scores of the Sample***

**Research question 2.** Research question 2 examined the pre-test and post-test TOVA auditory and visual skills test percentage of error scores and response time scores of the second through fifth grade students with attention difficulties who participated in this study. Results indicated total sample TOVA auditory errors of commission (impulsivity) decreased by 1.04, from 4.84 to 3.80 for the total sample, while auditory errors of omission (inattention) increased by 1.67, from 9.97 to 11.64 for the total sample. The largest decrease in auditory errors of commission (impulsivity) was among the experimental group (-1.37). This result supports Rickson's (2006) finding where non-

statistically significant reduced STT scores (measures of impulsivity) were found after an instructional music therapy session was delivered to ADHD boys. The largest increase in auditory errors of omission (inattention) was among the control group (3.17). Errors of omission are a measure of inattention and recorded when the student does not respond to the designated target. This finding suggests that, when applied to auditory skills, the World Music Drumming Program does not have the same effect on inattention as it does on impulsivity.

Total sample TOVA visual errors of commission (impulsivity) decreased by 1.46, from 7.47 to 6.01 for the total sample, while errors of omission (inattention) increased by 2.23, from 4.05 to 6.28 for the total sample. The largest decrease in errors of commission (impulsivity) was among the experimental group (-2.32). This result supports Rickson's (2006) finding where non-statistically significant reduced STT scores (measures impulsivity) were found after an instructional music therapy session was delivered to ADHD boys. The largest increase in errors of omission (inattention) was among the control group (3.16). Errors of omission are a measure of inattention and recorded when the student does not respond to the designated target. This finding suggests that, when applied to visual skills, the World Music Drumming Program does not have the same effect on inattention as it does on impulsivity.

Total sample TOVA auditory response time scores decreased for the total sample by 15.63 milliseconds, from 676.45 to 660.82, while TOVA visual response time scores increased by 38.40 milliseconds from 511.57 to 549.97. The largest decrease in auditory response time was among the experimental group (-19.63 milliseconds). The largest increase in visual response time was among the control group (62.87 milliseconds).

This finding is consistent with Shapiro et al. (1998), where ADHD children were identified as having a difficult time managing their behavioral responding, often showing inconsistencies in performance.

### ***Student Characteristics and TOVA Scores***

**Research question 3.** Research question 3 examined the relative contribution of gender, age, estimated grade level, and BASC classifications of second through fifth grade students with attention difficulties in explaining their TOVA scores. Estimated grade level was removed from the regression analysis after initial results showed a high correlation ( $r > .9$ ) between age and estimated grade level. For analyses related to total sample auditory skills, results of multiple regression analyses found significant models for auditory pre-test percentage of commission (impulsivity) error scores, the difference between pre-test and post-test commission (impulsivity) error scores, and pre-test and post-test response time. For analyses related to total sample visual skills, significant models were found for pre-test and post-test response time among both the experimental group and the control group.

Age had the greatest impact on auditory commission errors, followed by gender, and BASC classification. Results indicated an inverse relationship between age and gender, showing lower pre-test auditory skills errors of commission (impulsivity) were associated with older students and female students, while higher pre-test auditory errors of commission (impulsivity) were associated with males and younger students. This finding is consistent with the normative sample from the TOVA, which also indicated an inverse relationship between age and gender, with females and older students showing fewer auditory errors of commission (impulsivity) than males and younger students



(Greenberg, 2000). This finding also supports an earlier conclusion that girls typically do not manifest symptoms of ADHD the same as boys, showing fewer signs of inattentiveness, hyperactivity, and impulsivity, resulting in less girls being identified with ADHD than boys (August et al., 1996; Carlson et al, 1997; Gershon, 2002; Greenblatt, 1994; Wolraich et al., 1998; Zentall, 2006). Results also indicated a positive relationship between BASC classification and pre-test auditory errors of commission (impulsivity), such that lower pre-test auditory errors of commission (impulsivity) were associated with students classified as at-risk, while higher pre-test auditory errors of commission (impulsivity) were associated with students classified as clinically significant. This finding is consistent with the classifications of the BASC, where any score in the clinically significant range identifies a serious concern in a specific area and scores that fall in the at-risk range identify a possible concern that should be monitored (Reynolds & Kamphaus, 1992). Students classified at-risk on the BASC would by definition have fewer symptoms associated with ADHD, therefore, would naturally have lower pre-test auditory errors of commission, while students classified clinically significant on the BASC would have more symptoms associated with ADHD, and therefore, would naturally have higher auditory errors of commission (Reynolds & Kamphaus, 1992).

Age was a significant explanatory variable of the difference between total sample pre-test and post-test TOVA auditory skills errors of commission (impulsivity). Results indicated a positive relationship between student age and the difference between pre-test and post-test TOVA auditory skills percentage of commission (impulsivity) error scores. The positive relationship indicated smaller differences between pre-test and post-test percentage of commission (impulsivity) errors were associated with younger students,

while greater differences between pre-test and post-test percentage of errors of commission (impulsivity) were associated with older students. Descriptive characteristics of the sample indicated younger students were classified at-risk on the BASC more often than older students. This finding could explain the positive relationship between student age and the difference between pre-test and post-test TOVA auditory skills percentage of commission (impulsivity) error scores. If more students at a younger age were classified at-risk on the BASC, they would, by definition, show fewer symptoms associated with ADHD, and therefore, have smaller differences between pre-test and post-test auditory commission (impulsivity) error scores. Descriptive characteristics of the sample also indicated older students were classified clinically significant on the BASC more often than younger students. Again, this finding could explain the positive relationship between student age and the difference between pre-test and post-test TOVA auditory skills percentage of commission (impulsivity) error scores. If more students at an older age were classified clinically significant on the BASC, they would, by definition, have more symptoms associated with ADHD, and therefore, could have greater differences between pre-test and post-test auditory skills test percentage of commission (impulsivity) error scores. Shapiro et al. (1998) found children diagnosed with ADHD can show inconsistencies in behavioral responding. These inconsistencies in behavioral responding in children classified clinically significant could be the reason for greater differences between pre-test and post-test auditory commission (impulsivity) error scores.

Age was a significant explanatory variable of pre-test and post-test TOVA auditory skills response time scores for the total sample. Results indicated an inverse

relationship between student age and pre-test TOVA auditory skills response time scores. The inverse relationship indicated lower response time scores were associated with older students, while higher response time scores were associated younger students. This finding indicates that older students were able to respond quicker on the TOVA pre-test and post-test than younger students. It is believed that some children will learn to manage the symptoms associated with ADHD as they grow and mature (Silver, 1992). This finding may be a result of older students in the study learning how to manage the symptoms of ADHD over younger students.

Gender was a significant explanatory variable of the difference between the experimental group's pre-test and post-test TOVA auditory skills errors of commission (impulsivity). Results indicated a positive relationship between student gender and the difference between pre-test and post-test TOVA auditory percentage of commission (impulsivity) error scores. The positive relationship indicated smaller differences (smaller decreases) between pre-test and post-test percentage of commission (impulsivity) errors were associated with male students, while greater differences (greater decreases) between pre-test and post-test percentage of errors of commission (impulsivity) were associated female students. This finding suggests World Music Drumming as an intervention had more of an impact on the girls in the experimental group than on the boys. One possible explanation for this gender discrepancy is that past research has shown girls typically do not manifest symptoms of ADHD the same as boys (Zentall, 2006), while another is that girls have a tendency to be more receptive to redirection and intervention by the teacher than boys (Zentall, 2006). This finding may

have been a result of the girls' tendency to be more receptive to redirection and intervention by the drum circle leader over the boys (Zentall, 2006).

As with the TOVA auditory skills tests, age was a significant explanatory variable of total sample pre-test and post-test TOVA visual skills response time. Results indicated an inverse relationship between age and pre-test and post-test TOVA visual skills response time scores, such that younger participants had higher response times, while older participants had shorter response times. This finding suggests older students were able to respond more quickly on the TOVA visual pre-test than younger students. It is believed that some children will learn to manage the symptoms associated with ADHD as they grow and mature (Silver, 1992). This finding may be a result of older students learning how to manage the symptoms of ADHD over younger students.

BASC classification had a marginally significant, positive relationship with post-test TOVA visual response time scores, such that response times were higher for students classified as clinically significant and lower for those classified as at risk. This finding is consistent with the classifications of the BASC, where any score in the clinically significant range identifies a serious concern in a specific area and scores that fall in the at-risk range identify a possible concern that should be monitored (Reynolds & Kamphaus, 1992). Students that are classified at-risk on the BASC would, by definition, have fewer symptoms associated with ADHD and naturally have lower pre-test auditory skills errors of commission, while students classified clinically significant on the BASC would, by definition, have more symptoms associated with ADHD and naturally have higher auditory skills errors of commission.

### *Hypotheses*

Studies have found students had overall improvements in the areas of attention, motivation, and hostility after receiving either the active rhythm-based or passive listening-based music intervention technique (Montello & Coons, 1998). Rickson (2006) found non-statistically significant reduced STT scores (measures impulsivity) after an instructional music therapy session was delivered to ADHD boys. This study tested the effect of an instructional, rhythm-based music intervention (participation in the World Music Drumming program) on the auditory and visual attention skills of second through fifth grade students identified with attention difficulties. While findings supported Rickson (2006), findings did not support Montello & Coons (1998).

Table 5-2 provides a list of the three research hypotheses (H1, H2, and H3) tested in this study about the effect of participation in the seven-week World Drumming Music program on the experimental group's attention skills, as measured by TOVA auditory, visual, and response time scores, and summarizes results of analyses and linkages to the literature.

Table 5-2

*Experimental Group's Auditory, Visual, and Response Time*

Research Hypotheses	Results	Literature	Consistent with Literature
H1 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of error scores.			
H <sub>1a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of commission (impulsivity) error scores.	Supported	Rickson, 2006	Yes
H <sub>1b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test percentage of omission (inattention) error scores.	Not Supported	Montello & Coons, 1998	No
H2 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of error scores.			
H <sub>2a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores.	Supported	Rickson, 2006	Yes
H <sub>2b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual skills test percentage of omission (inattention) error scores.	Not Supported	Montello & Coons, 1998	No
H3 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA response time scores.			
H <sub>3a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA auditory skills test response time scores.	Not Supported	Shapiro, DuPaul, & Bradley-Klug, 1998	Yes
H <sub>3b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significant decrease in their TOVA visual response time scores.	Not Supported	Shapiro, DuPaul & Bradley-Klug, 1998	Yes

### ***Experimental Group's TOVA Auditory, Visual and Response Time Scores***

***Hypothesis 1.*** Hypothesis 1 tested for a significant difference in pre-test and post-test TOVA auditory skills test percentage of commission (impulsivity) error scores ( $H_{1a}$ ) and TOVA auditory skills test percentage of omission (inattention) error scores ( $H_{1b}$ ) among students who participated in the seven-week World Music Drumming Program. Results supported  $H_{1a}$ , indicating on average, students who participated in the seven-week World Music Drumming program had a significant decrease in their percentage of TOVA auditory skills test errors of commission (impulsivity) when comparing their pre-test and post-test scores. Results of nonparametric analyses on  $H_{1a}$  indicated the experimental group's TOVA auditory skills test percentage of commission (impulsivity) error scores were significantly lower on the post-test than on the pre-test. The analyses also indicated a large change in percentage of error of commission scores was experienced by those students who participated in the seven-week World Music Drumming program. This result supports Rickson's (2006) finding where non-statistically significant reduced STT scores (measures impulsivity) were found after an instructional music therapy session was delivered to ADHD boys. Errors of commission are a measure of impulsivity and record when a student incorrectly responded to a non-target. Students who participated in the World Music Drumming intervention reduced their errors of commission on the TOVA, Auditory post-test, which could be explained as a result of the World Music Drumming intervention. This finding supports Rickson's (2006) finding that instructional music therapy reduced impulsivity in ADHD boys. This finding could also be explained as a result of the student's inattentiveness. If the students that participated did not consistently pay attention throughout the TOVA, Auditory, the error of

incorrectly responding to a non-target would not consistently occur, therefore, reducing their errors of commission.

Based on the finding by Montello and Coons (1998) that active rhythm-based music therapy resulted in overall improvements in the area of attention, motivation, and hostility, students who participated in the seven-week World Music Drumming program were expected to decrease their percentage of TOVA auditory skills test errors of omission (inattention). Findings indicated there was no significant decrease in the percentage of TOVA auditory skills test errors of omission (inattention) of students who participated in the seven-week World Music Drumming program when comparing their pre-test and post-test scores. Therefore,  $H_{1b}$  was not supported. Errors of omission are a measure of inattention and record when the student did not respond to the designated target. Based on the fact that students who participated in the study are ADHD at-risk or ADHD clinically significant, these students would have difficulty focusing their attention on completing the TOVA, Auditory. If the students had difficulty focusing, they would not consistently respond to the designated target, and therefore, their errors of omission would not significantly be reduced. Findings could also be explained in terms of the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

***Hypothesis 2.*** Hypothesis 2 tested for a significant difference in pre-test and post-test TOVA visual skills test percentage of commission (impulsivity) error scores ( $H_{2a}$ )



and TOVA visual skills test percentage of omission (inattention) error scores (H2<sub>b</sub>). Results supported H2<sub>a</sub>, indicating on average, students who participated in the seven-week World Music Drumming program had a significant decrease in their percentage of TOVA visual skills test errors of commission (impulsivity) when comparing their pre-test and post-test scores. Results of nonparametric analyses on H2<sub>a</sub> also indicated the experimental group's TOVA visual skills test percentage of commission (impulsivity) error scores were significantly lower on the post-test than on the pre-test. This result supports Rickson's (2006) finding, where non-statistically significant reduced STT scores (measures impulsivity) were found after an instructional music therapy session was delivered to ADHD boys. Errors of commission are a measure of impulsivity and record when a student incorrectly responded to a non-target. Students who participated in the World Music Drumming intervention reduced their errors of commission on the TOVA, Visual post-test, which could be explained as a result of the World Music Drumming intervention. This finding supports Rickson's (2006) finding that instructional music therapy reduced impulsivity in ADHD boys. This finding could also be explained as a result of the student's inattentiveness. If the students that participated did not consistently pay attention throughout the TOVA, Visual, the error of incorrectly responding to a non-target would not consistently occur, therefore, reducing their errors of commission.

Based on the finding by Montello and Coons (1998) that active rhythm-based music therapy resulted in overall improvements in the area of attention, motivation, and hostility, students who participated in the seven-week World Music Drumming program were expected to decrease their percentage of TOVA visual skills test errors of omission

(inattention). There was no significant decrease in the percentage of TOVA visual skills test errors of omission (inattention) of students who participated in the seven-week World Music Drumming program when comparing their pre-test and post-test scores. Therefore, H2<sub>b</sub> was not supported. Errors of omission are a measure of inattention and record when the student did not respond to the designated target. Based on the fact that students who participated in the study are ADHD at-risk or ADHD clinically significant, these students would have difficulty focusing their attention on completing the TOVA, Visual. If the students had difficulty focusing, they would not consistently respond to the designated target, and therefore, their errors of omission would not significantly be reduced. Findings could also be explained in terms of the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

**Hypothesis 3.** Hypothesis 3 tested for a significant difference in pre-test and post-test TOVA auditory skills test response time scores (H3<sub>a</sub>) and TOVA visual skills test response time scores (H3<sub>b</sub>). Results of H3<sub>a</sub> and H3<sub>b</sub> were not supported, indicating students who participated in the seven-week World Music Drumming program did not have a significant decrease in their auditory skills test response time scores or their visual skills test response time scores when comparing pre-test and post-test scores. This finding could be explained in light of the inconsistencies in performance ADHD children display (DuPaul & Stoner, 2002, 2003). Due to the symptoms of the disorder, children diagnosed with ADHD often have a difficult time managing their behavior in order to

respond appropriately (Shapiro et al., 1998), which could explain no significant decrease in response time scores on the TOVA auditory and visual skills test between pre-test and post-test administration. Another possible explanation for H3<sub>a</sub> and H3<sub>b</sub> not being supported is found in Barkley's Inhibition Model (1997), which states a deficit in response inhibition is the key to understanding ADHD. Barkley proposed that a person diagnosed with ADHD does not have the ability to manage behavior in certain environments (Barkley, 1994), which could explain TOVA response time scores not significantly decreasing between pre-test and post-test administration. Results of nonparametric analyses on H3<sub>b</sub> indicated the experimental group's TOVA auditory skills test response time scores were marginally significant. This finding is also consistent with Shapiro et al. (1998), indicating that children diagnosed with ADHD will show inconsistencies in behavioral responding. Findings could also be explained in terms of the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

Table 5-3 provides a list of the three research hypotheses (H4, H5, and H6) tested in this study about the effect of non-participation in the seven-week World Drumming Music program on the control group's attention skills, as measured by TOVA auditory, visual, and response time scores, and summarizes results of analyses and linkages to the literature.

Table 5-3

*Control Group's Auditory, Visual, and Response Time*

Research Hypotheses	Results	Literature	Consistent with Literature
H4 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of error scores.			
H <sub>4a</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of commission (impulsivity) error scores.	Supported	Zentall, 1975	Yes
H <sub>4b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test percentage of omission (inattention) error scores.	Supported	Zentall, 1975	Yes
H5 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test percentage of error scores.			
H <sub>5a</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores.	Supported; Nonparametric Analysis did not support	Zentall, 1975	Yes; No
H <sub>5b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test percentage of omission (inattention) error scores.	Supported	Zentall, 1975	Yes
H6 Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA response time scores.			
H <sub>6a</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA auditory skills test response time scores.	Supported	Shapiro, DuPaul, & Bradley-Klug, 1998	Yes
H <sub>6b</sub> Second through fifth grade students with attention difficulties who do not participate in the seven-week World Music Drumming program will not have a significant decrease in their TOVA visual skills test response time scores.	Supported	Shapiro, DuPaul, & Klug, 1998	Yes

### ***Control Group's TOVA Auditory, Visual and Response Time Scores***

***Hypothesis 4.*** Hypothesis 4 tested for the absence of a significant difference in pre-test and post-test TOVA auditory skills test percentage of commission (impulsivity) error scores (H4<sub>a</sub>) and TOVA auditory skills test percentage of omission (inattention) error scores (H4<sub>b</sub>) among students who did not participate in the seven-week World Music Drumming program. Based on Zentall's Optimal Stimulation Theory (1975), ADHD children need more stimulation than non-ADHD children and are more sensitive to a less stimulating environment. Students who did not participate in the seven-week World Music Drumming program did not receive the same amount of stimulation over the seven-week period as the students who participated in the program. Therefore, students who did not participate in the seven-week World Music Drumming program were not expected to decrease their percentage of TOVA auditory skills test errors of commission (impulsivity) scores and TOVA auditory skills test errors of omission (inattention) scores. Results supported H4<sub>a</sub>, indicating on average, students who did not participate in the seven-week World Music Drumming program did not have a significant decrease in their percentage of TOVA auditory skills test errors of commission (impulsivity) when comparing their pre-test and post-test scores. Results also supported H4<sub>b</sub>, indicating on average, students who did not participate in the seven-week World Music Drumming program did not have a significant decrease in their percentage of TOVA auditory skills test errors of omission (inattention) when comparing their pre-test and post-test scores. Nonparametric tests corroborated these findings.

**Hypothesis 5.** Hypothesis 5 tested for the absence of a significant difference in pre-test and post-test TOVA visual skills test percentage of commission (impulsivity) error scores (H5<sub>a</sub>) and TOVA visual skills test percentage of omission (inattention) error scores (H5<sub>b</sub>) among students who did not participate in the seven-week World Music Drumming program. Based on Zentall's Optimal Stimulation Theory (1975), ADHD children need more stimulation than non-ADHD children and are more sensitive to a less stimulating environment. Students who did not participate in the seven-week World Music Drumming program did not receive the same amount of stimulation over the seven-week period as the students who participated in the program. Therefore, students who did not participate in the seven-week World Music Drumming program were not expected to decrease their percentage of TOVA visual skills test errors of commission (impulsivity) scores and TOVA visual skills test errors of omission (inattention) scores. Results supported H5<sub>a</sub>, indicating on average, students who did not participate in the seven-week World Music Drumming program did not have a significant decrease in their percentage of TOVA visual skills test errors of commission (impulsivity) when comparing their pre-test and post-test scores. Results also supported H5<sub>b</sub>, indicating on average, students who did not participate in the seven-week World Music Drumming program did not have a significant decrease in their percentage of TOVA visual skills test errors of omission (inattention) when comparing their pre-test and post-test scores. Results of nonparametric analyses for H5<sub>a</sub> and H5<sub>b</sub> showed the control group's percentage of TOVA visual skills errors of commission (impulsivity) scores were significantly lower on the post-test than on the pre-test. Errors of commission are a measure of impulsivity and record when a student incorrectly responded to a non-target.

This finding could be explained as a result of the student's inattentiveness. If the students in the control group did not consistently pay attention throughout the TOVA, Visual post-test, the error of incorrectly responding to a non-target would not consistently occur, therefore, reducing their errors of commission. Findings could also be explained in terms of the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation. No significant decrease was found for the TOVA visual skills test percentage of omission errors. While results of nonparametric tests did support H5<sub>a</sub>, results of nonparametric tests did support H5<sub>b</sub>. Based on Zentall's Optimal Stimulation Theory (1975), ADHD children need more stimulation than non-ADHD children and are more sensitive to a less stimulating environment. Students who did not participate in the seven-week World Music Drumming program did not receive the same amount of stimulation over the seven-week period as the students who participated in the program. Therefore, students who did not participate in the seven-week World Music Drumming program were not expected to decrease their percentage of TOVA visual skills test errors of omission (inattention) scores.

***Hypothesis 6.*** Hypothesis 6 tested for the absence of a significant difference in pre-test and post-test TOVA auditory skills test response time scores (H6<sub>a</sub>) and TOVA visual skills test response time scores (H6<sub>b</sub>) among student who did not participate in the World Music Drumming program. Results of H6<sub>a</sub> and H6<sub>b</sub> were supported, indicating students who did not participate in the seven-week World Music Drumming program did



not have a significant decrease in their auditory skills test response time scores or their visual skills test response time scores when comparing pre-test and post-test scores. While there was no significant decrease in their TOVA visual response time scores when comparing their pre-test and post-test scores, there was a significantly large increase. Results of nonparametric analyses on H6<sub>a</sub> and H6<sub>b</sub> likewise indicated there was no significant decrease in the control group's TOVA auditory and visual response time scores. This finding could be explained in light of the inconsistencies in performance ADHD children display (DuPaul & Stoner, 2002, 2003). Due to the symptoms of the disorder, children diagnosed with ADHD often have a difficult time managing their behavior in order to respond appropriately (Shapiro et al., 1998), which could explain no significant decrease in response time scores on the TOVA auditory and visual skills test between pre-test and post-test administration. Findings could also be explained in terms of the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

Table 5-4 provides a list of the three research hypotheses (H7, H8, and H9) tested in this study about the difference in TOVA auditory, visual and response time scores between students who did participate in the seven-week World Drumming Music Program and those who did not participate, and summarizes results of analyses and linkages to the literature.



Table 5-4

*Experimental vs. Control Group Differences in Auditory, Visual, and Response Time*

Research Hypotheses	Results	Literature	Consistent with Literature
H7 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test percentage of errors than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.			
H7 <sub>a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test percentage of commission (impulsivity) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	Not Supported	Rickson, 2006	Yes
H7 <sub>b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test percentage of omission (inattention) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	Not Supported	Montello & Coons, 1998	No
H8 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of errors than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.			
H8 <sub>a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of commission (impulsivity) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	Not Supported	Rickson, 2006	Yes
H8 <sub>b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test percentage of omission (inattention) error scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	Not Supported	Montello & Coons, 1998	No

Table 5-4, Continued

Research Hypotheses	Results	Literature	Consistent with Literature
H9 Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.			
H9 <sub>a</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA auditory skills test response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	Not Supported	Shapiro, DuPaul, & Bradley-Klug, 1998	Yes
H9 <sub>b</sub> Second through fifth grade students with attention difficulties who participate in the seven-week World Music Drumming program will have a significantly greater decrease in their TOVA visual skills test response time scores than will second through fifth grade students with attention difficulties who did not participate in the World Music Drumming program.	Not Supported	Shapiro, DuPaul, & Bradley-Klug, 1998	Yes

### ***Experimental vs. Control Group Differences in TOVA Auditory, Visual, and Response Time Scores***

**Hypothesis 7.** Hypothesis 7 tested the difference between participation and nonparticipation in the seven-week World Music Drumming program on TOVA auditory skills test percentage of commission (impulsivity) error scores (H7<sub>a</sub>) and TOVA auditory skills test percentage of omission (inattention) error scores (H7<sub>b</sub>). Results indicated students in the experimental group experienced a greater decrease in their TOVA auditory skills percentage of commission (impulsivity) error scores than did those students who did not participate in the program. Although the experimental group experienced a greater decrease than the control group, the difference was not significant and therefore H7<sub>a</sub> was not supported. This finding supports Rickson (2006), where non-

statistically significant reduced STT scores (measures impulsivity) were found after an instructional music therapy session was delivered to ADHD boys. Errors of commission are a measure of impulsivity and record when a student incorrectly responded to a non-target. Students who participated in the World Music Drumming intervention experienced a greater decrease in their TOVA auditory skills percentage of commission (impulsivity) error scores than did those students who did not participate in the program, which could be explained as a result of the World Music Drumming intervention. This finding supports Rickson's (2006) finding that instructional music therapy reduced impulsivity in ADHD children. This finding could also be explained as a result of the student's inattentiveness. If the students that participated did not consistently pay attention throughout the TOVA, Auditory, the error of incorrectly responding to a non-target would not consistently occur, therefore, reducing their errors of commission.

Based on the finding by Montello and Coons (1998) that active rhythm-based music therapy resulted in overall improvements in the area of attention, motivation, and hostility, students who participated in the seven-week World Music Drumming program were expected to have a greater decrease in their percentage of TOVA auditory skills test errors of omission (inattention) than students who did not participate in the program. Results indicated neither group experienced a significant decrease in their TOVA auditory skills percentage of omission (inattention) error scores; scores for each group actually increased. Therefore, H7<sub>b</sub> was not supported. Increases were lower among the students in the experimental group than among students in the control group, but the difference was not significant.

Nonparametric results were consistent with parametric analyses. Errors of omission are a measure of inattention and record when the student did not respond to the designated target. Based on the fact that students who participated in the study are ADHD at-risk or ADHD clinically significant, these students would have difficulty focusing their attention on completing the TOVA, Auditory. If the students had difficulty focusing, they would not consistently respond to the designated target, and therefore, their errors of omission would not significantly be reduced. Findings could also be explained in terms of the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

**Hypothesis 8.** Hypothesis 8 tested the difference between participation and no participation in the seven-week World Music Drumming program on TOVA visual skills test percentage of commission (impulsivity) error scores (H8<sub>a</sub>) and TOVA visual skills test percentage of omission (inattention) error scores (H8<sub>b</sub>). Results indicated students in the experimental group experienced a greater decrease in their TOVA visual skills percentage of commission (impulsivity) error scores than did those students who did not participate in the program. This difference was not significant, therefore, H8<sub>a</sub> was not supported. This finding supports Rickson (2006), where non-statistically significant reduced STT scores (measures impulsivity) were found after an instructional music therapy session was delivered to ADHD boys. Errors of commission are a measure of impulsivity and record when a student incorrectly responded to a non-target. Students

who participated in the World Music Drumming intervention reduced their errors of commission on the TOVA, Visual post-test, which could be explained as a result of the World Music Drumming intervention. This finding supports Rickson's (2006) finding that instructional music therapy reduced impulsivity in ADHD boys. This finding could also be explained as a result of the student's inattentiveness. If the students that participated did not consistently pay attention throughout the TOVA, Visual, the error of incorrectly responding to a non-target would not consistently occur, therefore, reducing their errors of commission.

Based on the finding by Montello and Coons (1998) finding that active rhythm-based music therapy resulted in overall improvements in the area of attention, motivation, and hostility, students who participated in the seven-week World Music Drumming program were expected to have a greater decrease in their percentage of TOVA visual skills test errors of omission (inattention) than students who did not participate in the program. Results indicated neither group experienced a decrease in their TOVA visual skills percentage of omission (inattention) error scores. Therefore, H<sub>8b</sub> was also not supported. Both the experimental group and the control group experienced increases in scores. Although increases were lower among the students who participated in the seven-week World Music Drumming program than those who did not participate in the program, the difference was not significant.

Nonparametric results were consistent with parametric analyses. Errors of omission are a measure of inattention and record when the student did not respond to the designated target. Based on the fact that students who participated in the study are ADHD at-risk or ADHD clinically significant, these students would have difficulty

focusing their attention on completing the TOVA, Visual. If the students had difficulty focusing, they would not consistently respond to the designated target, and therefore, their errors of omission would not significantly be reduced. Findings could also be explained in terms of the Hawthorne effect, where the knowledge by a subject that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

***Hypothesis 9.*** Hypothesis 9 tested for a difference between participation and no participation in the seven-week World Music Drumming program on TOVA auditory skills test response time scores (H9<sub>a</sub>) and TOVA visual skills test response time scores (H9<sub>b</sub>). Results indicated students in the experimental group experienced a greater decrease in their TOVA auditory skills response time scores than students in the control group, but the difference was not significant. Neither the experimental group nor the control group experienced a decrease in their visual skills response time scores. Therefore, neither H9<sub>a</sub> nor H9<sub>b</sub> were supported. Both groups experienced an increase in their visual skills response time scores. Increases were significantly lower among students in the experimental group than the control group. Nonparametric results were consistent with parametric analyses. The findings could be explained in light of the inconsistencies in performance ADHD children display (DuPaul & Stoner, 2002, 2003). Due to the symptoms of the disorder, children diagnosed with ADHD often have a difficult time managing their behavior in order to respond appropriately (Shapiro et al., 1998), which could explain no significant decrease in response time scores on the TOVA

auditory and visual skills test between pre-test and post-test administration. Findings could also be explained in terms of the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

### **Limitations**

1. The sample used in this study was one of convenience, which resulted in a small sample of students from a specific geographic region. This weakens the external validity of the study by limiting the generalization of experimental findings to a larger population.
2. The sample characteristics that made up the experimental group and the control group were different in terms of the gender, age, grade level, and BASC classification. Therefore, the internal validity of the study was threatened due to the experimental group and the control group not being similar in characteristics.
3. Due to the nature of the classic experimental design that was used, the pre-test may have affected the outcome of the post-test. Findings could have been influenced by the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). Because the students understood that the pre-test was measuring their auditory and visual attention skills, this could have affected their participation in the treatment and also their post-test performance. Because a classic experimental

design was used, the interaction of the testing situation and experimental stimulus was a threat to the internal validity of this study.

4. Due to time limits on completing the study by the end of the academic school year, the TOVA, Auditory and Visual, post-test was given throughout the entire school day. This may have had an affect on the results since the TOVA was normed with test administration in the morning, prior to 1 p.m. to avoid diurnal variations.
5. The TOVA Administrative Manual recommends that the test administrator be physically present throughout testing. As a result of the study being conducted at the researcher's job site during the regular school day, the test administrator (researcher) was not always present throughout the entire administration of the TOVA, Auditory and Visual. This may have influenced the results of the study.
6. The TOVA post-test was administered shortly before the end of the school year. Findings may have been affected by the student's lack of attention due to the anticipation of summer vacation.
7. This research study was conducted by the guidance counselor at a South Florida elementary school during the regular school day. Proper attention was not always given to the study due to the researcher's job responsibilities as the guidance counselor at the school site.

### **Implications for Theory and Practice**

Research has shown that medication treatment is the first line of defense to assist children in overcoming symptoms of ADHD. While stimulant medication has shown results in treating symptoms of ADHD (Abikoff & Gittleman, 1985; Zuvekas, 2006),



some suggest treatment will be most effective when pharmacological treatment is paired with psychosocial, behavioral, and cognitive-behavioral treatment strategies (Greene & Ablon, 2001; Hoza, 2001; Pelham & Gnagy, 1999). The majority of studies support these interventions in the treatment of ADHD (Greene & Ablon, 2001; Hoza, 2001; Pelham & Gnagy, 1999), with few supporting a non-pharmacological approach alone (Abikoff & Gittleman, 1985; Zuvekas, 2006). This study demonstrated an education-based drumming intervention may significantly affect some symptoms of ADHD, without medication.

The finding that participation in the seven-week World Music Drumming program had a significant effect on auditory and visual skills test percentage of commission (impulsivity) error scores adds to Barkley's Inhibition Model of ADHD and other related research. Barkley's Inhibition Model (1997) states ADHD is a deficit in response inhibition, which is due to problems in the prefrontal region of the brain, resulting in impulsivity. Earlier, Barkley (1994) proposed a person diagnosed with ADHD lacks the ability to self-regulate behavior in specific environments. Other researchers agree that prefrontal brain abnormalities are related to motor timing deficits that lead to impulsiveness in children (Berquin et al., 1997). Zentall (2006) reports impulsivity is related to a lack of internally regulated motivation. This result adds to Rickson's (2006) finding, where non-statistically significant reduced STT scores (measures of impulsivity) were found after an instructional music therapy session was delivered to ADHD boys.

Montello and Coons (1998) found students had overall improvements in motivation after receiving either the active rhythm-based or passive listening-based music

intervention technique. Based on the research cited above, this researcher suggests ADHD is a deficit in response inhibition or impulsivity (Barkley, 1997), which is related to motor timing deficits (Berquin et al, 1997) and a lack of internally regulated motivation (Zentall, 2006). Because it has been shown that active rhythm-based or passive listening-based music interventions improve motivation (Montello & Coons, 1998), and impulsivity is related to a lack of internally regulated motivation (Zentall, 2006), the making of steady beats of music while participating in drum circle activities should reduce impulsivity in ADHD children.

### **Conclusions**

1. This study supports earlier findings that suggest gender is a factor in identifying children with ADHD; with boys identified with ADHD symptoms more often than girls (August et al., 1996; Carlson et al., 1997; Gershon, 2002; Greenblatt, 1994; Wolraich et al., 1998; Zentall, 2006).
2. Participation in the seven-week World Music Drumming program had a significant effect on the auditory and visual skills test percentage of commission (impulsivity) error scores of students with ADHD at-risk and clinically significant BASC classifications in the area of attention at a South Florida elementary school. This finding supports earlier research that suggests ADHD is a deficit in impulse control (Barkley, 1997), which can be improved by instructional music therapy (Rickson, 2006).
3. Participation in the seven-week World Music Drumming program did not significantly decrease the auditory and visual skills test percentage of omission (inattention) error scores of students with ADHD at-risk and clinically significant

BASC classifications in the area of attention at a South Florida elementary school. Results showed students' auditory and visual skills percentage of omission (inattention) error scores actually increased between pre-test and post-test administration. This finding is inconsistent with earlier findings where students who participated in active rhythm-based music therapy showed improvement in the areas of attention (Montello and Coons, 1998). Errors of omission are a measure of inattention and record when the student did not respond to the designated target. Based on the fact that students who participated in the study are ADHD at-risk or ADHD clinically significant, these students would have difficulty focusing their attention on completing the TOVA, Visual. If the students had difficulty focusing, they would not consistently respond to the designated target, and therefore, their errors of omission would not significantly be reduced. Findings could also be explained in terms of the Hawthorne effect, where the knowledge by a subject that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

4. Although auditory skills response time scores decreased for both the experimental and control groups when comparing their pre-test and post-test scores, the decrease was not significant according to parametric tests. When performing nonparametric tests, auditory skills test response time scores were found to be marginally significant for the experimental group. Therefore, participation in the

seven-week World Music Drumming program did not have a significant effect on visual skills response time scores of students with ADHD at-risk and clinically significant BASC classifications in the area of attention at a South Florida elementary school, but it did have a marginally significant effect on auditory skills response time scores. The findings could be interpreted and explained in light of the inconsistencies in performance ADHD children display (DuPaul & Stoner, 2002, 2003). Due to the symptoms of the disorder, children diagnosed with ADHD often have a difficult time managing their behavior in order to respond appropriately (Shapiro et al., 1998), which could explain no significant decrease in response time scores on the TOVA auditory and visual skills test between pre-test and post-test administration. Findings could also be interpreted in terms of the Hawthorne effect, where the knowledge by a subject that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

5. Visual skills response time scores increased for both the experimental and control groups when comparing their pre-test and post-test scores. This increase was not significant for the experimental group, but it was a significant increase for the control group. The findings could be explained in light of the inconsistencies in performance ADHD children display (DuPaul & Stoner, 2002, 2003). Due to the symptoms of the disorder, children diagnosed with ADHD often have a difficult time managing their behavior in order to respond appropriately (Shapiro et al.,

1998), which could explain no significant decrease in response time scores on the TOVA auditory and visual skills test between pre-test and post-test administration. Findings could also be explained in terms of the Hawthorne effect, where the knowledge by a subject that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have also been affected by the student's lack of attention due to the anticipation of summer vacation.

### **Recommendations for Future Study**

The small target and accessible population available to the researcher weakened the external validity of the study by limiting the generalization of experimental findings to a larger population. The use of a larger population from which to select students would strengthen the external validity of future studies by allowing the experimental findings to be generalized to the larger population.

The sample characteristics that made up the experimental group and the control group were different in terms of the gender, age, grade level, and BASC classification. Therefore, the internal validity of the study was threatened due to the experimental group and the control group not being similar in characteristics. The use of stratified random sampling to assign participants to the experimental and control groups would permit future studies to have experimental and control groups with similar characteristics in terms of gender, age, grade level, and BASC classifications, therefore, strengthening the internal validity of the study.

Due to the nature of the classic experimental design that was used, the pre-test may have affected the outcome of the post-test. Findings could have been influenced by the Hawthorne effect, where the subject's knowledge that an experiment is being conducted may affect the results (Ary et al., 1990; Babbie, 2001). Because the students understood that the pre-test was measuring their auditory and visual attention skills, this could have affected their participation in the treatment and also their post-test performance. Because a classic experimental design was used, the interaction of the testing situation and experimental stimulus was a threat to the external validity of this study. Controlling for the Hawthorne effect by not informing students that the study is measuring their attention skills in future studies will strengthen the internal validity of the study.

Due to time limits on completing the study by the end of the academic school year, the TOVA, Auditory and Visual, post-test was given throughout the entire school day. This may have had an affect on the results since the TOVA was normed with test administration in the morning, prior to 1 p.m. to avoid diurnal variations. Future studies should administer the TOVA, Auditory and Visual during the morning hours to avoid diurnal variations.

The TOVA Administrative Manual recommends that the test administrator be physically present throughout testing. As a result of the study being conducted at the researcher's job site during the regular school day, the test administrator (researcher) was not always present throughout the entire administration of the TOVA, Auditory and Visual. This may have influenced the results of the study. Future research should be

conducted with the researcher present throughout the entire administration of the TOVA, Auditory and Visual.

It should be noted that the TOVA post-test was administered shortly before the end of the school year. Findings may have been affected by the student's lack of attention due to the anticipation of summer vacation. Future studies should be conducted during the summer or at the beginning of the school year when students are well rested.

This research study was conducted by the guidance counselor at a South Florida elementary school during the regular school day. Future studies should be conducted in a more controlled environment to avoid distractions and allow the researcher to give full attention to the study.

This study only examined the influence of gender, age, estimated grade level, and BASC classification on student's TOVA scores. Future studies might benefit from analyzing the effect of additional sociodemographic characteristics such as race and ethnicity, and medication type and dosage on TOVA scores.

The level of attention difficulty of each student was measured at an ordinal level based on an at-risk or clinically significant BASC classification. To permit better analysis, future studies should use scaled BASC scores in place of the BASC classification.

This study sought to add to the knowledge about the effect of a nonpharmacological intervention on the attention skills of students identified with attention difficulties. Chapter V discussed the results of analyses related to answering the research questions and testing the hypotheses that flowed from the research purposes of this study. Findings were interpreted in light of the review of literature. Implications for

theory and practice as well as the conclusions drawn from interpretations were also discussed. The limitations of the study and recommendations for future study were addressed.



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**Appendix A**  
**TOVA Permission**

**THE T.O.V.A.® RESEARCH FOUNDATION**  
2129 Larpenteur Avenue West  
St. Paul, Minnesota 55113 USA

To: Shannon Michael Chacona

Re: Your Research Application

Date: December 8, 2004

I am pleased to inform you that your application has been approved and you can call UAD for service and support for duration of your project.

If you have any questions about the procedure, please contact Tammy Dupuy, [REDACTED] or by e-mail [REDACTED]

Sincerely,

The T.O.V.A. Research Foundation

Phone: [REDACTED] [REDACTED] [REDACTED] du

## **Appendix B**

### **TOVA Permission to use Figures and Tables**

**From:** "Lawrence M. Greenberg" [REDACTED]  
**To:** [REDACTED]  
**CC:** [REDACTED]  
**Subject:** Permission to use reliability and validity tables in dissertation  
**Date:** Wednesday, February 07, 2007 1:17:26 PM

Dear Shannon:

You have my permission to include the information cited below in your dissertation.

I look forward to receiving a copy of the dissertation when it's been accepted.

Sincerely,

Lawrence Greenberg, MD Author of the T.O.V.A.

The TOVA Company  
4281 Katella Ave. #215,  
Los Alamitos, CA 90720

Phone: [REDACTED]  
[REDACTED]

<http://www.tovatest.com> <http://www.tova.net>

-----Original Message-----

**From:** [REDACTED]  
**Sent:** Thursday, February 01, 2007 10:47 AM  
**To:** [REDACTED]  
[REDACTED] use reliability and validity tables in dissertation

Hi Tammy. I am emailing you for permission to use one figure and several tables from the TOVA manual in my dissertation. My dissertation committee said I needed permission to incorporate the TOVA tables. Here is a list of the ones that I would like to incorporate: Figure 1, which shows the visual target and non-target that appears on the computer screen when taking the TOVA, Visual. And also, Tables 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, and 32. These tables show the reliability and validity of the instrument from when it was developed. I would also like to use the instructions verbatim in my dissertation to show what was read to each student prior to being administered the TOVA. I will reference that script. Thanks for your help, Tammy. You can email me back at this address. Have a good afternoon.

**Appendix C**  
**School District Permission**



THE SCHOOL DISTRICT OF  
PALM BEACH COUNTY, FLORIDA

RESEARCH, EVALUATION, AND ACCOUNTABILITY  
3370 FOREST HILL BOULEVARD, B-202  
WEST PALM BEACH, FL 33406-5871

(561) 434-8850 FAX: (561) 434-8736

ARTHUR C. JOHNSON, Ph.D.  
SUPERINTENDENT

April 30, 2004

Mr. Shannon Michael Chacona  
[REDACTED]

Dear Mr. Chacona:

The School District of Palm Beach County (District) procedures only require an employee to submit an application to conduct research when the data-gathering activity is outside their job function. Accordingly, as a guidance counselor at Coral Sunset Elementary School, you do not need permission from the District to conduct your research providing you obtain permission from your University's Institutional Review Board.

If your research requires the use of additional schools in the future, you must first submit an application to conduct research and then wait for a response before proceeding.

Sincerely,  
[REDACTED]

Marc Baron, Ph.D.  
Executive Director  
Research, Evaluation, and Accountability

MB:bls

c: Carole Shetler, South Area Superintendent  
Gary Hagermann, Principal

L:\Research Requests\FY04\S M Chacona.doc

AN EQUAL OPPORTUNITY EMPLOYER

**Appendix D**  
**IRB Approval**





Lynn University

Principal Investigator: Shannon Michael Chacona

Project Title: What Effect Does World Music Drumming Have On The Auditory And Visual Attention Of Students At Florida Elementary School?

IRB Project Number 2004-030 :  
APPLICATION AND PROTOCOL FOR REVIEW OF RESEARCH INVOLVING HUMAN SUBJECTS OF  
NEW PROJECT: Request for Exempt Status ☐ Expedited Review ☐ Convened Full-Board ☒

IRB ACTION by the CONVENED FULL BOARD *If Applicable*

Date of IRB Review of Application and Research Protocol 2/16/05  
IRB ACTION: Approved ☒ Approved w/provision(s) ☐ Not Approved ☐ Other ☐

COMMENTS

Consent Required: No ☐ Yes ☒ Not Applicable ☐ Written ☒ Signed ☒  
Consent forms must bear the research protocol expiration date of 02/16/06.

Application to Continue/Renew is due:

(1) For an Convened Full-Board Review, two months prior to the due date for renewal ☒

Other Comments: In addition to the parental consent, Child assent is also required.

Name of IRB Chair (Print) Farideh Farazmand

Signature of IRB Chair \_\_\_\_\_ Date: 2/16/05

Cc. Dr. Leary

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Lynn University  
3601 N. Military Trail Boca Raton, Florida 33431

**Appendix E**  
**Parental Consent**



Lynn University

To the Parents of: \_\_\_\_\_

**PROJECT TITLE:** What Effect Does World Music Drumming Have On The Auditory And Visual Attention Of Students At A South Florida Elementary School?

Project IRB Number: \_\_\_\_\_ Lynn University 3601 N. Military Trail Boca Raton, Florida 33431

2004-030

I, Shannon Michael Chacona, am a doctoral student at Lynn University. I am studying Global Leadership, with a specialization in Educational Leadership. Part of my education is to conduct a research study.

**DIRECTIONS FOR THE PARTICIPANT'S PARENT:**

You are being asked to give permission for your son or daughter to participate in my research study. Please read this carefully. This form provides you with information about the study. The Principal Investigator (Mr. Chacona) will answer all of your questions. Ask questions about anything you don't understand before deciding whether or not to have your child participate. Your child's participation is entirely voluntary and he or she can refuse to participate without penalty.

**PURPOSE OF THIS RESEARCH STUDY:** This research study is interested in what effect the World Music Drumming Program has on the auditory and visual attention skills of elementary school students. There will be approximately 60 students participating in the study. The students will range from First Grade through Fifth Grade.

**PROCEDURES:** The students participating in the research study will be randomly selected from a sample of the student population that has been previously identified with at-risk or clinically significant attention scores on the Behavior Assessment System for Children (BASC). Students will then be randomly divided into the experimental group and the control group. A pre-test will be administered to both the experimental and control groups using the Test of Variables of Attention (T.O.V.A.), Auditory and Visual. The experimental group will receive the World Music Drumming Program as treatment for 30 minutes, twice a week for seven weeks (fourteen sessions) in order to see if there is any effect on auditory and visual attention skills. The control group will not receive the World Music Drumming Program as treatment over the seven week period. After the treatment, the experimental and control group will be given the T.O.V.A., Auditory and Visual, as a post-test. This research study hypothesizes that the World Music Drumming Program will improve the auditory and visual attention of students with attention difficulties.

**POSSIBLE RISKS OR DISCOMFORT:** This study involves minimal risk. One risk or negative aspect to the research study is that students participating in the program will miss a half hour of instruction time per meeting or one hour per week. This has been addressed through the support of the

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Lynn University  
3601 N. Military Trail Boca Raton, Florida 33431



administration and teachers in the program, with students being excused from class with no penalty and given the opportunity to make up assigned class work under teacher supervision.

**POSSIBLE BENEFITS:** Students participating in the research study will have an opportunity to be involved in an exciting drumming program with the possibility of increasing their auditory and visual attention skills.

**FINANCIAL CONSIDERATIONS:** There is no financial compensation for your child's participation in this research. There are no costs to you as a result of your child's participation in this study.

**CONFIDENTIALITY:** Every effort will be made to maintain the confidentiality of this research study. Your child's identity in this study will be treated as confidential. All the data gathered during this study will be kept strictly confidential. Data will be stored in a locked filing cabinet throughout the study and destroyed at the end of the research. All information will be held in strict confidence and may not be disclosed unless required by law or regulation.

The results of this study may be published in a dissertation, scientific journals or presented at professional meetings. In addition, your child's individual privacy will be maintained in all publications or presentations resulting from this study.

**RIGHT TO WITHDRAW:** You are free to choose whether or not to allow your child to participate in this study. Your child may choose to withdraw from the study at any time without penalty.

**CONTACTS FOR QUESTIONS/ACCESS TO CONSENT FORM:** Any further questions you have about this study or your child's participation in it, either now or any time in the future, will be answered by Mr. Chacona (Principal Investigator) who may be reached at: [REDACTED] and Dr. William J. Leary, faculty advisor who may be reached at: [REDACTED]. For any questions regarding your rights as a research subject, you may call Dr. Farazmand, Chair of the Lynn University Institutional Review Board for the Protection of Human Subjects, at [REDACTED]. If any problems arise as a result of your child's participation in this study, please call the Principal Investigator (Mr. Chacona) and the faculty advisor (Dr. Leary) immediately. A copy of this consent form will be given to you.

**AUTHORIZATION FOR VOLUNTARY CONSENT:**

I have read and understand this consent form. I have been given the opportunity to ask questions, and all my questions have been answered to my satisfaction. I have been assured that any future questions that may arise will be answered. I understand that all aspects of this project will be carried out in the strictest of confidence, and in a manner in which my child's rights as a human subject are protected. I have been informed of the risks and benefits. I have been informed in advance as to what my child's task(s) will be and what procedures will be followed.

I choose to allow my child to participate in the research study. I know that my child can withdraw this consent to participate at any time without penalty or prejudice. I understand that by signing this form I have not waived any of my or my child's legal rights. I further understand that nothing in this consent form is intended to replace any applicable Federal, state, or local laws. I understand that I will receive a copy of this form.

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Lynn University  
3601 N. Military Trail Boca Raton, Florida 33431



\_\_\_\_\_  
Participant's printed name

\_\_\_\_\_  
Parent's signature

\_\_\_\_\_  
Date

**INVESTIGATOR'S AFFIDAVIT:** I have carefully explained to the subject's parent the nature of the above project. I hereby certify that to the best of my knowledge the person who is signing this consent form understands clearly the nature, demands, benefits, and risks involved in his/her child's participation and his/her signature is legally valid.

\_\_\_\_\_  
Signature of Investigator

Date of IRB Approval: 02/16/05 7.7.

**CHILD ASSENT: This statement will be read to each student after parental permission is granted.**

I am studying how the World Music Drumming Program affects the attention skills of elementary school students. I am going to have you play a computer game which involves you concentrating on things you hear and see. After, a group of you will participate in the World Music Drumming Program for 30 minutes, twice a week for approximately seven weeks. After the seven weeks, I am going to have all of you play the same computer game again. The students who did not get to participate in the first drumming group will have the opportunity to participate at the end of the program. Your parents have given you permission to participate in this study. You do not have to participate if you do not want to. If at any point you decide you do not want to continue participating in the study, you may stop and return to class.

Student Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**WITNESS STATEMENT:**

In my judgment, the subject understands the information in this consent form and agrees to be in the study.

Witness Signature: \_\_\_\_\_

Date: \_\_\_\_\_



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Lynn University  
3601 N. Military Trail Boca Raton, Florida 33431

## **Appendix F**

### **Instructions for Administering the TOVA, Auditory**

This test measures your ability to pay attention. Two different kinds of notes will be heard. The notes will differ only in that one of them will be higher in pitch than the other. I want you to press this button every time you hear this sound. I want you to hold this button in your writing hand with your thumb resting lightly on top. Here, take the button. Let up when you hear the click; don't hold the button down very long. Push it down only once for each correct note. Now we are going to play the notes, and your job is to press the button as fast as you can every time you hear the high note. But the trick is that you are not to press the button when the low note is heard. Remember, press the button as fast as you can, but only for the high note. The whole idea of this test is for you to be as fast, but also as accurate as you can. Try not to make any mistakes. But, if you do make a mistake, don't get upset, and don't worry. Everyone can make a mistake on this test. Try and press the button as fast as you can but only for the high note. Don't be too fast. Take enough time to hear which note it is. Don't guess. Once you've pressed the button, let up. Don't press it more than once when you hear the correct signal. Do you have any questions? Now we are going to have a short practice. When I press a key on the computer, the notes will begin. After I press the key, the numbers 3, 2, 1, are going to appear and then the first note will be heard. Remember, the whole idea is to be as fast and accurate as you can be. Do you have any questions? After the 3-minute practice was over, the following was read: Okay, now we are going to do the test for about 20 minutes. Do the best job you can. Also, you should know that you are probably going to get a little tired. Even so, try and do the best job you can. Press the button as quickly as you can but only for the high note. I'll be staying here while you do the test,

but I can't talk to you once the test starts. Do you have any questions before we begin?

Ready, here we go. Start listening. At this time the test will begin.



## **Appendix G**

### **Instructions for Administering the TOVA, Visual**

This test measures your ability to pay attention. Two different kinds of squares will flash on this computer screen. The squares will differ only in that one of them will have a small hole near the top and one will have the hole near the bottom. I want you to press this button every time you see the square with the hole near the top. I want you to hold this button in your writing hand with your thumb resting lightly on top. Here, take the button. Let up when you hear the click; don't hold the button down very long. Push it down only once for each correct picture. Now we are going to flash the squares on the screen and your job is to press the button as fast as you can every time you see a square with a hole near the top. But the trick is that you are not to press the button when the hole is near the bottom. Remember, press the button as fast as you can, but only for the square with the hole near the top. The whole idea of this test is for you to be as fast, but also as accurate as you can. Try not to make any mistakes. But, if you do make a mistake, don't get upset, don't worry. Everyone can make a mistake on this test. Try and press the button as fast as you can but only for the square with the hole in the top. Don't be too fast. Take enough time to see which picture it is. Don't guess. Once you've pressed the button, let up. Don't press it more than once when you see the correct signal. Do you have any questions? Now we are going to have a short practice. After you press the button, you are going to see a dot appear in the middle of the screen. That's where the squares are going to appear. After the dot appears, the numbers 3, 2, 1, are going to appear and then the first square will flash on the screen. Remember, the whole idea is to be as fast and accurate as you can be. Do you have any questions? After the 3-minute practice was over, the following was read: Okay, now we are going to do the test for about 20 minutes. Do the best job you can. Also, you should know that your eyes are

probably going to get a little tired. Even so, try and do the best job you can, press the button as quickly as you can but only for the square with the hole in the top. I'll be staying here while you do the test, but I can't talk to you once the test starts. Do you have any questions before we begin? Ready, here we go, start watching the screen. At this time the test will begin.

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Group  
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